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FACILITIES AND EQUIPMENT AVAILABLE FOR TEACHING SCIENCE IN PUBLIC HIGH SCHOOLS, 1958-59.

BY- SOLBERG, ARCHIE N. KOELSCHE, CHARLES L.

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SURVEYS WERE CONDUCTED TO DETERMINE THE AVAILABILITY OF HIGH SCHOOL SCIENCE FACILITIES AND EQUIPMENT IN SEVEN STATES. THIS WAS ACCOMPLISHED THROUGH PERSONAL INSPECTIONS BY A PROJECT COMMITTEE, USING CHECKLISTS OF APPROXIMATELY 850 SCHOOLS SELECTED AT RANDOM. AN ANALYSIS OF THE DATA WAS THEN MADE, AND SOME GENERAL IMPLICATIONS WERE SUGGESTED. COMBINATION CLASSROOMS AND MULTIPURPOSE LABORATORIES WERE DESIGNATED AS IDEAL FACILITIES FOR SCIENCE INSTRUCTION. MANY OF THE HIGH SCHOOLS SURVEYED, HOWEVER, WERE STILL USING REGULAR CLASSROOMS FOR TEACHING SCIENCE, AND OTHER SCHOOLS HAVING SCIENCE FACILITIES WERE INADEQUATELY EQUIPPED FOR EFFECTIVE INSTRUCTION. ROUGHLY ONE-HALF OF THE HIGH SCHOOLS LACKED ADEQUATE SPACE FOR LABORATORY WORK, AND ONE-THIRD LACKED PROPER SCIENCE EQUIPMENT STORAGE FACILITIES. IN ADDITION, ABOUT 55 PERCENT HAD ANNUAL BUDGETS FOR SCIENCE SUPPLIES AND EQUIPMENT, BUT MANY OF THESE FUNDS WERE OBVIOUSLY INADEQUATE. IT WAS DETERMINED THAT IN MANY SCHOOLS THESE CONDITIONS COULD BE RECTIFIED WITH SOME LONG-RANGE PLANNING FOR STEADY IMPROVEMENT IN THE VARIETY AND QUANTITY OF LABORATORY AND OTHER INSTRUCTIONAL EQUIPMENT, AND IN THE ENLARGEMENT AND MODERNIZATION OF INSTRUCTIONAL FACILITIES. THE SEVEN PARTICIPATING STATES WERE FLORIDA, ILLINOIS, MASSACHUSETTS, NORTH DAKOTA, OHIO, SOUTH CAROLINA, AND WISCONSIN. (JH)

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Facilities and Equipment Available for Teaching Science in Public High Schools 1958-1959

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by

Charles L. Koelsche
Specialist for Science
U. S. Office of Education

and

Archie N. Solberg
Dean of Research
University of Toledo

RESEARCH FOUNDATION
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FOREWARD

Not so many years ago there was in the United States not a single public high school and only scattered, small elementary schools. But if this land were to be covered over tonight by another continental glacier and then after some thousands of years the remains of the United States of America were unearthed, the archaeologists of that distant time would be perhaps most puzzled by the frequency of the red brick buildings which marked that lost civilization. Truly, the public school is the hallmark of the United States in the twentieth century. It stands as a tribute to a country's belief in the purposefulness of life and man's ability to better himself.

We have not built up a vast empire of classrooms to house millions of pupils and hundreds of thousands of their teachers merely because some educators and far-sighted statesmen have advocated it. Our educational system has grown by a grand design and is so much a part of our everyday life that we are scarcely conscious of it. The compulsory attendance laws, the extension of public school facilities to greater numbers of our people - almost always without regard to their color, national origin, sex, wealth or lack of wealth - these have been achieved more slowly than we might have wished, but with a consistent trend toward universality. Yet there is a wide diversity of opportunity dependent upon the interest of citizens of any particular community in support of the schools.

From this study it is painfully apparent that you cannot have good schools on a pinchpenny budget. I am not suggesting a spendthrift budget but if schools are expected to operate by cutting every corner at the expense of good instruction, if children are in half-session because of the unwillingness to buy adequate buildings, if laboratory equipment is not modern or even lacking entirely, if a community expects to turn out first-class citizens from second-class surroundings and atmosphere - then those citizens in that community are just fooling themselves because it can't be done.

While the nation cries for action in the preparation of scientists, many of our public schools are required to watch from the sidelines, unable even to accomplish the preliminary planning that we all know is so necessary. This is an item which must receive the highest of priorities. The study by Doctors Koelsche and Solberg of facilities and equipment available for teaching science in public high schools should be a first essential step in planning our future needs.

William S. Carlson
President
The University of Toledo

PREFACE

Improvement of science education in the public high schools of the United States is necessary if we expect to close the gap between the public's knowledge and understanding of science and the achievements of science. Science teachers in these schools are in a strategic position to locate, stimulate, and nurture young people with capabilities toward careers and leadership roles in science and technology.

In order for those who have competence in science and teaching to stimulate the creative intellect, adequate facilities and equipment should be available, not only for their use, but also for the use of science students. High schools should know the status of their facilities and equipment to determine needs in meeting the challenge of science in the atomic and space era.

This investigation was a study of what facilities and equipment were available for teaching science in the public high schools of Florida, Illinois, Massachusetts, North Dakota, Ohio, South Carolina, and Wisconsin.

The authors are indebted to the directors in the seven states who organized a team of interviewers from among their University colleagues and outstanding high school teachers or administrators; helped with the design of the study and reviewed and contributed to the text. They were:

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Raymond C. Yeasley

Ohio

T. Handley Diehl
William English
Walter A. Farmer, Jr.
David A. Feindt
W. Lee Foust, Jr.
E. C. Hostetler
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Charles L. Koelsche

Archie N. Solberg

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INTRODUCTION

Evidence continues to indicate the need for change in emphasis during high school education. Since the early thirties, considerable time has been given to the so-called "social aspects of education" while, in the opinion of some educators, business men, and professional people, too little time has been devoted to the study of subjects in certain academic areas. Relationships between human experience and science have become so closely allied that today an educated person cannot afford to be without some knowledge and understanding of science. To guide a change in emphasis toward the most desirable ends, serious consideration should be given to the findings of research in the field.

During the past few years, some outward signs have appeared which indicate that an improvement in the quality of high school science education programs is taking place. Curriculum reorganization has taken an unmistakably quickening tempo. One well-publicized effort has produced the Physical Science Study Committee's physics course. The American Institute of Biological Sciences has begun recently an investigation which should lead ultimately to new high school biology courses; a corresponding study has been initiated in chemistry. Complete courses in physics and chemistry have been filmed and are available to high schools wishing to use them. A course in classical and modern physics has been televised. A similar course in chemistry is being presented during the 1959-60 school year. The use of "open-ended" experiments and semi-micro laboratory techniques in chemistry is expanding. Advance courses are appearing in the curriculum of some high schools. An increasing number of high school science teachers

are participating in expanded in-service and institute programs designed for the improvement of subject-matter competency.

These are all encouraging signs. Another aspect, however, of quality instruction in science is the role played by facilities and equipment. An investigation of what facilities and equipment are available for teaching science in the high schools provides data on their present status. With this information, schools are able to make comparisons with approved lists of equipment and facilities thus enabling them to determine items needed to bring their science facilities up to adequate standards.

This project on science facilities and equipment is a natural sequal to other status studies reported by the U. S. Office of Education, National Education Association, state agencies, and individuals. Some of these previous studies dealt with school size, science offerings, enrollments in the various science classes, teaching combinations in science and other academic or non-academic subjects, the frequency and distribution of full-time and part-time science teachers, and the total teaching load carried by instructors teaching one or more science classes. Other studies dealt with colleges attended by science teachers, semester hours of credit earned in the five major areas of science and in professional education, type of teaching certificate held, status as a science teacher, science subjects taught, number of years in present and former teaching position(s), and salary.

The study, herewith reported, was concerned with an investigation of high school and science enrollments, science offerings, the nature of room and laboratory facilities for the teaching of science, fiscal arrangements for and administrative practices employed in the procurement of equipment and supplies, sources of borrowed and donated equipment, and the

quantity of demonstration and laboratory equipment available for teacher and student use.

The procedures used for securing data pertinent to the problem involved three steps. They were:

1. Compilation of the sample. The sample consisted of 855 high schools selected at random from the three, four, and six-year high schools operating during the 1958-59 academic year in Florida, Illinois, Massachusetts, North Dakota, Ohio, South Carolina, and Wisconsin. Representative schools for the sample were identified by: (a) numbering consecutively the three types of high schools in each state's 1958-59 school directory; (b) drawing numbers from the table of random numbers compiled by Fisher and Yates until the quantity equaled 25 percent of the high schools in each state; and (c) matching these numbers with the corresponding ones assigned the high schools.

2. Collection of data. The data were collected by school visitations and conferences with high school administrators and science teachers. A state director for the project was named in each of the seven states. Each director named the state committee members who visited the schools and secured data firsthand. The persons selected were either high school science teachers, county or state science consultants, or college or university professors of science or science education.

To establish uniform procedures for visiting the schools, gathering data, and handling fiscal and other matters related to the study, the project's coordinators met with each state committee. Following a general discussion of the project and procedures, the interview guide-sheets and checklists were studied, item by item. Additional state meetings or individual conferences with state directors were arranged as needed.

When the collection of data was completed, final state meetings were held. Each person discussed briefly his visitation experiences. An overall evaluation of the present status of facilities and equipment for teaching high school science was formulated.

3. Tabulation of data. The completed data sheets from the seven states were brought together for final editing. Information was transferred from the lists to IBM punch cards. Data were then processed on IBM machines. Classification categories were based upon school enrollment, science enrollment, science offerings, presentation and laboratory facilities, general provisions for procuring equipment, and equipment inventories.

FINDINGS RELEVANT TO ENROLLMENTS

Data pertinent to this category were analyzed with respect to size and type of the high schools, grade and total enrollments, science offerings, science class enrollments, and ratios between total, grade, and science enrollments.

The tabulated data concerning the size and type of the 855 high schools comprising the sample are given in Table 1.

TABLE 1. NUMBER OF HIGH SCHOOLS IN THE SAMPLE, GROUPED AS TO THEIR 1958-59 ENROLLMENT AND TYPE

Type of School		Size of School				
		1-199	200-499	500-999	1000-up	Totals
Six-year	Grades 7-12	147	100	33	2	282
Four-year	Grades 9-12	229	147	75	61	512
Three-year	Grades 10-12	3	10	21	27	61
* Totals		379	257	129	90	855

* These totals are applicable in all tables throughout this report.

According to these data, 636 or 74.4 percent of the 855 high schools had enrollments of less than 500, and 379 or 44.3 percent had fewer than 200 students. About one-fourth of the schools had enrollments of more than 500, while roughly one-tenth had 1000 or more students.

It was further noted that one-third of the high schools were six-year schools containing grades 7 through 12, three-fifths were regular four-year schools, and about one-fourteenth were three-year senior high schools. In this investigation, data on the 7th and 8th grades in six-year high schools were eliminated from consideration.

The type of school district organization is somewhat influenced by school population. In the combined enrollment categories below 500, 38.8 percent of the schools were six-year junior-senior high schools; 59 percent were regular four-year high schools; and 2.2 percent were senior high schools. In the 500-999 enrollment category, 16 percent were junior-senior high schools; 62 percent were regular four-year high schools; and 22 percent were senior high schools. In the 1000-up size group, 2.2 percent were six-year high schools; 67.8 percent were regular four-year high schools; and 30 percent were senior high schools. It would appear, therefore, that as school size increases, there is a tendency for the number of six-year junior-senior high schools to decrease, and for the number of three-year senior high schools to increase.

Table 2 shows the compilation of data pertaining to the number of students enrolled in the high schools, tabulated by grade and size of school.

TABLE 2. NUMBER OF STUDENTS ATTENDING THE HIGH SCHOOLS, CATEGORIZED BY GRADE AND SIZE OF SCHOOL

Grade	Size of School				
	1-199	200-499	500-999	1000-up	Totals
Ninth (Freshmen)	12215	23017	21367	31082	87681
Tenth (Sophomore)	11544	22710	26909	48489	109652
Eleventh (Junior)	10395	19401	22771	41385	93952
Twelfth (Senior)	8765	15811	18104	32747	75427
Totals	42919	80939	89151	153703	366712

An analysis of these data discloses that approximately one-third of the students were enrolled in high schools with enrollments of less than 500, and almost one-fourth of the students were attending schools with

enrollments of 500-999. Schools in the 1000 up category enrolled slightly more than two-fifths of the total students. Even though there were 44.8 percent of the schools in the 1-199 size group, only one-ninth of the students were enrolled in these schools.

Considering grade enrollments, the distribution of students was about as follows: almost one-fourth were freshmen; three-tenths were sophomores; one-fourth were juniors; and one-fifth were seniors, Ninth grade total enrollment was low because the senior high schools in the sample enrolled no freshmen students. Furthermore, the number of seniors compared with the number of sophomores was greatest in the small schools and the smallest in the 1000-up enrollment category. On the average, the ratio was about seven seniors to ten sophomores.

Science offerings of the 855 high schools are given in Table 3.

An examination of these data reveals that general science was offered in 86.8 percent of the high schools; biology in 95.5 percent of the schools; chemistry in 74.5 percent of the schools; physics in 71 percent; and "others" in 23.2 percent.

During the 1958-59 school year, courses in biology, chemistry, and physics were offered in 95 percent or more of the high schools with enrollments of 500 and above. In schools enrolling fewer than 500 students, a smaller percent offered these basic science courses. Of the "others" courses, physical science and advanced general science were the most popular offerings in the category of schools with the smallest enrollment, while physiology and these two courses predominated the offerings in the largest schools.

The number of schools offering the various "other" science courses may exceed the totals given in the "others" row because some schools offered

TABLE 3. NUMBER OF HIGH SCHOOLS OFFERING THE VARIOUS SCIENCE COURSES, CATEGORIZED BY SUBJECT AND SIZE OF SCHOOL

Subjects	Size of School				
	1-199	200-499	500-999	1000-up	Totals
General Science	332	240	107	62	741
Biology	346	253	129	88	816
Chemistry	189	233	126	88	636
Physics	185	210	126	85	606
Others*	31	58	54	55	196
*Advanced Biology	1	2	10	10	23
*Advanced Chemistry	1	1	6	7	15
*Advanced General Science	9	23	14	18	64
*Aeronautics	0	0	0	3	3
*Botany	0	2	2	7	11
*Conservation	1	6	2	4	13
*Electronics	0	3	3	2	8
*Geology	2	2	0	3	7
*Meteorology	0	0	0	1	1
*Photography	0	1	0	4	5
*Physical Geography	1	1	2	4	8
*Physical Science	20	23	25	19	87
*Physiology	0	6	10	27	43
*Zoology	0	2	0	6	8

two or more of these courses.

Data on science enrollments are given in Table 4.

The compiled data in this table indicate that in the 855 high schools more students studied biology than any other science subject. Popularity

TABLE 4. NUMBER OF SCIENCE CLASS SECTIONS, THEIR TOTAL ENROLLMENTS, AND AVERAGE SIZE OF SCIENCE CLASSES IN THE HIGH SCHOOLS

Subjects		Size of School				
		1-199	200-499	500-999	1000-up	Totals
Gen. Sci.:	Sections	469	713	611	724	2517
	Enrollment	11346	19902	17809	21424	70481
	Average	24	28	29	29.5	28
Biology:	Sections	476	718	824	1308	3326
	Enrollment	10405	19202	22300	37959	89866
	Average	22	27	27	29	27
Chemistry:	Sections	216	378	420	677	1691
	Enrollment	3589	8006	9979	15656	37230
	Average	16.5	21.0	24	23	22
Physics:	Sections	192	232	223	404	1051
	Enrollment	2593	3714	4502	9727	20536
	Average	13.5	16	20	24	19.5
Others:	Sections	40	90	120	292	542
	Enrollment	632	1793	3210	9796	15431
	Average	16	20	27	33.5	28.5
Total Science Enrollment		28565	52617	57800	94562	233544

of the other science offerings followed in this order: general science, chemistry, physics, and "others." The more popular science subjects included in the "others" category, arranged in the order of their descending popularity, were: physical science, advanced general science, physiology, and advanced biology. Individually, their total enrollments were smaller than those in the four traditional science courses.

Enrollments in general science class sections were generally greater

than those in other sciences. Physics classes were usually the smallest. Even though high schools in the 1000-up enrollment category offered twice as many sections of "other" science courses as did the schools in the other size groups, the average class size of these courses was still considerably greater in these large schools than in the smaller ones.

Table 5 shows by percents the ratios between science enrollments, grade enrollments, and total school enrollments.

TABLE 5. ENROLLMENTS IN SCIENCE CLASSES COMPARED WITH SCHOOL AND GRADE ENROLLMENTS, RECORDED AS PERCENTS

Items	Size of School				
	1-199	200-499	500-999	1000-up	Totals
% of total enrollment in science classes	66.5	65.0	64.9	61.5	63.7
% in general science	26.5	24.6	20.0	14.0	19.2
* % of freshmen class in general science	92.8	86.5	78.5	69.0	80.3
% in biology	24.3	23.7	25.0	24.7	24.5
* % of sophomore class in biology	90.0	84.5	82.8	78.3	82.0
% in chemistry	8.4	9.9	11.2	10.2	10.2
* % of junior class in chemistry	35.9	41.2	42.9	37.9	39.7
% in physics	6.0	4.6	5.1	6.3	5.6
* % of senior class in physics	29.6	23.5	24.9	29.7	27.2
% in other sciences	1.5	2.2	3.6	6.4	4.2

* It was recognized that these percents might be slightly distorted due to the enrollment of other class members; i.e., a few juniors and seniors could have enrolled in biology along with sophomores.

According to Table 5, 63.7 percent of the students enrolled in the 855 high schools were attending science classes. The percent of

attendance was the highest in the 1-199 enrollment group and the lowest in the 1000-up category. It was further noted that 19.2 percent of the students were enrolled in general science, 24.5 percent were in biology, 10.2 percent in chemistry, and 5.6 percent in physics. Four and two-tenths percent of the students were studying one or more of the "other" science courses.

In comparing the number of students enrolled in the various science courses with the enrollment of the grade level in which the science course is usually offered, it was found that 80.3 percent of the freshmen students were enrolled in general science; 82.0 percent of the sophomores were in biology; 39.7 percent of the juniors in chemistry; and 27.2 percent of the seniors in physics.

A relationship between school size and science enrollments was discernible. The portion of total high school enrollment in general science decreased as the size of the schools increased. This was partially due to the fact that some senior high schools in the larger enrollment categories did not offer general science. On the other hand, the portion of total school enrollment in chemistry, physics, and "other" sciences tended to increase as school size increased. The portion of enrollment in biology was about the same in the several categories of school size, but the percent of sophomores enrolled in biology declined as school size increased.

Summary on enrollments. The random sample, composed of 282 junior-senior high schools, 512 regular four-year high schools, and 61 senior high schools, represented 25 percent of the public secondary schools operating during the 1958-59 academic year in Florida, Illinois, Massachusetts, North Dakota, Ohio, South Carolina, and Wisconsin.

Almost three-fourths (74.4%) of the high schools had enrollments of

less than 500, and somewhat less than one-half (44.3%) enrolled fewer than 200 students. Approximately one-tenth (10.5%) enrolled 1000 or more students. There were 366,712 students enrolled at the 855 high schools. Even though there were 379 or 44.3 percent of the schools in the 1-199 size category, only one-ninth of the students were enrolled at these small schools. On the other hand, only 219 or 25.6 percent of the schools were in the 500-999 and 1000-up size categories, but two-thirds of the students were enrolled at the larger schools. In this investigation, data on the 7th and 8th grades in six-year high schools were disregarded.

All high schools in the sample offered one or more courses in science. General science was offered in 86.8 percent of the schools; biology in 95.5 percent; chemistry in 74.5 percent; physics in 71 percent; and "others" in 23.2 percent. These percents would probably vary some from year to year because many of the schools alternated physics with chemistry, and biology with general science. Of the "other" sciences, physical science, advanced general science, and physiology were the most popular.

Based upon the 1958-59 enrollment statistics, 63.7 percent of the students attending the 855 high schools were enrolled in science courses. They were assigned in such a way that 19.2 percent were taking general science; 24.5 percent were in biology; 10.2 percent in chemistry; 5.6 percent in physics; and 4.3 percent in other science courses. Comparing the number of students in each of the four traditional science courses with the total enrollment of the grade level in which the course is usually offered, it was noted that 80.3 percent of the freshmen were enrolled in general science; 82 percent of the sophomores were in biology; 39.7 percent of the juniors in chemistry; and 27.2 percent of the seniors in physics.

FINDINGS PERTINENT TO SCIENCE TEACHING FACILITIES

Information pertinent to this category was analyzed with respect to the types of rooms in which instruction was given; nature of the presentation, laboratory, and certain miscellaneous facilities; and general observations on science teaching facilities.

Types of rooms. A compilation of data on certain types of science classrooms is shown in Table 6.

TABLE 6. NUMBER OF SCHOOLS IN WHICH VARIOUS TYPES OF ROOMS WERE USED BY SCIENCE CLASSES

Types of Rooms	Size of School				
	1-199	200-499	500-999	1000-up	Totals
Combination classroom & lab; one science area	77	116	165	146	504
Combination class. & lab; two or more science areas	251	215	70	26	562
Regular classroom; no science room available	65	47	30	15	157
Regular classroom; movable lect.-dem. table	11	5	7	2	25
Separate classroom & lab; one science area	12	33	36	49	130
Separate classroom & lab; two or more science areas	62	59	20	11	152

Interpretation of these data discloses that combination classroom and laboratory equipped for one science area and the same for two or more science areas were found in 59 and 65.8 percent respectively of the high schools. Almost one in every five schools had no special science room

available; science classes, therefore, were taught in regular classrooms. About one in every six schools held science classes in separate classrooms and laboratories equipped for two or more science areas. Types of rooms used the least were separate classroom and laboratory equipped for one science area and a regular classroom equipped with a movable lecture-demonstration table.

Types of rooms available for science instruction varied with the size of the high schools. The most prevalent type of room used by schools enrolling fewer than 500 students was a combination classroom and laboratory (multipurpose room) for two or more science areas. Large high schools had more combination classrooms and laboratories equipped for a single science area than any other type of science classroom. In schools enrolling 1000 or more students, only 2.2 percent had regular classrooms equipped with movable lecture-demonstration tables.

In the 855 high schools, there were 1988 rooms used for science instruction. The average number of such rooms per school in the several enrollment categories was: 1-199, 1.2 rooms; 200-499, 2 rooms; 500-999, 3.3 rooms; and 1000-up, 6.8 rooms.

Presentation, laboratory, and certain miscellaneous facilities. The presence of various presentation facilities is shown in Table 7.

An analysis of these data reveals that 854 of the 855 high schools had chalkboards in science rooms. These 1979 rooms had an average of 53.5 square feet of usable board space. Assuming chalkboard panels to be 42 inches in height, this area would provide an average of 15.3 linear feet of usable board space per room.

On further analysis, it was found that 90 percent of these high schools had science rooms equipped with A.C. electrical outlets; bulletin

TABLE 7. NUMBER OF SCHOOLS IN WHICH CERTAIN SCIENCE PRESENTATION FACILITIES WERE OBSERVED

Facility	Size of School				
	1-199	200-499	500-999	1000-up	Totals
A.C. electrical outlet	368	256	129	90	843
Bulletin board	335	253	128	89	805
Chalkboard	379	257	129	89	854
Compressed air outlet	10	13	15	35	73
D.C. electrical outlet	29	53	78	67	227
Elevated seating or elevated lecture-demon. desk	32	44	50	64	190
Filmstrip projection equipment is available	353	256	129	90	828
Fume hood	99	121	76	64	360
Gas outlet	305	254	129	90	778
Lecture-demonstration desk or table	311	253	129	89	782
Motion picture projection equipment is available	369	256	129	90	844
Room can be darkened for projection purposes	251	216	118	87	672
Running water in room	348	255	129	90	822
Slide projection equipment is available.	340	252	129	90	811

boards; running water; gas outlets; and lecture-demonstration desks. Picture projection equipment was available in more than 95 percent of the schools, but only 79 percent of them had science rooms which could be darkened for projection purposes. Fume hoods were present in approximately four out of every 10 schools. Fewer than 30 percent of the schools had science rooms with elevated student seating or an elevated lecture-

demonstration desk, D. C. electrical outlets, and compressed air outlets.

In the majority of cases, the variety of presentation facilities available in science classrooms varied with the size of the school. For instance, 10 of the 14 (71.3%) listed presentation facilities were available for science instruction in 95 percent of the high schools in the 1000-up enrollment category; nine of the 14 (63.3%) were available in 95 percent of the schools in the 500-999 size group; nine of the 14 (63.3%) in 95 percent of the schools in the 200-499 category; and only three of the 14 (21.4%) in 95 percent of the schools in the smallest enrollment category.

An exception to this analysis was the chalkboard. In the 1-199 enrollment category, 75.6 square feet - approximately 21.6 linear feet - of usable board space were available in each of the 454 science classrooms. As the school size increased, so did the number of science classrooms per school, but the chalkboard space in each room diminished. The chalkboard space per room in the 200-499, 500-999, and 1000-up school size groups was: 61.5 - 17.6; 55.5 - 15.9; and 29.3 - 8.4 square - linear feet, respectively.

Compilation of data pertaining to laboratory facilities is given in Table 8.

According to Table 8, A.C. electrical outlets was the only science laboratory facility available in 90 percent of the high schools. Closed storage cupboards were available in 89 percent of the schools. Between 70 and 80 percent of the schools had laboratories equipped with gas outlets on each table (78.8%), running water and a sink or trough on each desk or table (76.2%), separate storage and supply room (73%), and student equipment lockers (71.2%). The following items of laboratory facilities were found in between 50 and 70 percent of the schools; window and wall shelves

TABLE 8. NUMBER OF SCHOOLS IN WHICH CERTAIN SCIENCE LABORATORY FACILITIES WERE OBSERVED

Facility	Size of School				
	1-199	200-499	500-999	1000-up	Totals
A.C. electrical outlet in room	350	256	129	90	825
Closed storage cupboards	320	227	125	90	762
Compressed air outlet available in room	8	14	14	31	67
D.C. electrical outlet in room	18	48	71	66	203
Fume hood	111	145	102	74	432
Gas outlet on each table	223	239	125	86	673
Open reagent and/or storage shelves	128	135	100	75	438
Separate storage and supply room	170	237	129	88	624
Student equipment lockers available in laboratory	185	219	119	86	609
Water & sink in room but not on each desk or table	168	155	112	87	522
Water & sink or trough on each table or desk	215	230	121	85	651
Window and wall shelves	167	156	122	90	535

(62.5%); running water and a sink in room but not on each desk or table (61%); reagent and/or storage shelves (51.2%); and fume hood (50.5%).

D.C. electrical outlets and compressed air outlets were available in less than one-fourth of the high schools.

Large high schools as a group had better laboratory facilities than those found in small schools. In the largest enrollment category, seven of the 12 listed laboratory facilities were found in 95 percent of the schools,

while only five out of 12, one out of 12, and none out of 12 respectively were present in 95 percent of the schools in the other three size groups.

Table 9 shows the number of schools which had certain miscellaneous science facilities.

TABLE 9. NUMBER OF SCHOOLS IN WHICH CERTAIN MISCELLANEOUS SCIENCE FACILITIES WERE OBSERVED

Facility	Size of School				
	1-199	200-499	500-999	1000-up	Totals
Animal room or house	2	4	8	21	35
Book reference material available in classroom	208	213	125	85	631
Dark room available for photography	77	159	112	82	430
Exhibit cases	69	101	92	86	348
Periodical & reference material in library	288	256	129	90	763
Periodical material available in classroom	135	156	108	85	484
Plant growing room or greenhouse	7	19	32	40	98
Preparation or teacher work room	48	110	100	90	348
Safe audio-visual equipment storage space	260	215	127	90	692
Separate office space for personal use of teacher	35	61	58	60	214
Separate project room for student use	13	21	23	26	83
Stock or storeroom easily accessible	183	236	128	90	637

The compiled data in this table show that science periodical and

reference materials were available in 90.3 percent of the high school libraries, while 72.8 percent of them had book reference materials in their science classrooms. Only 56.5 percent of the schools had periodicals in their science rooms. Nearly three-fourths of the schools had conveniently located stock or storage rooms, and about four-fifths of them had satisfactory storage space for audio-visual equipment. Exhibit cases were found in four out of every ten schools.

It was further noted that certain other rooms were present in limited numbers. Five out of every 10 high schools had dark rooms for photographic work, while four in 10 provided a preparation or teacher workroom. Separate office space for the personal use of each science teacher was available in one-fourth of the schools.

Fewer than 12 percent of the high schools had an animal room or house, a plant growing room or greenhouse, and a separate project room for the exclusive use of students.

The influence of school size on availability of miscellaneous science facilities was discernible. In the largest enrollment category, eight of the 12 listed miscellaneous facilities were found in 90 percent of the high schools, while only four out of 12, two out of 12, and none out of 12 respectively were present in 90 percent of the schools in the other three size groups.

General observations on science facilities. The classification of certain observations on science teaching facilities is shown in Tables 10A and 10B.

An examination of these data reveals that 90 percent or more of the high schools had adequate lighting in their science classrooms and laboratories. Ventilation was adequate in most of the science classrooms, but

TABLE 10A. NUMBER OF SCHOOLS ABOUT WHICH CERTAIN OBSERVATIONS ON SCIENCE TEACHING FACILITIES WERE RECORDED

Items	Size of School				
	1-199	200-499	500-999	1000-up	Totals
Lighting in classrooms was adequate	349	252	128	89	818
Lighting in laboratories was adequate	318	252	128	90	788
Minor enlargement and modernization is possible	124	120	81	64	389
Stockroom storage facilities were adequate	161	188	120	86	555
Ventilation in classrooms was adequate	341	247	128	85	801
Ventilation in laboratories was adequate	289	241	128	87	745

it was inadequate in 13 percent of the science laboratories.

Ninety-four percent of the high schools having enrollments of 500 and above had adequate science stockroom storage facilities, while 55 percent of the schools enrolling fewer than 500 students had adequate storage facilities.

Minor enlargement and modernization of existing facilities could be accomplished in 45.5 percent of the high schools. A breakdown by school size showed that twice as many schools in the larger enrollment categories as those in the smaller ones had facilities which could readily be remodeled.

According to Table 10B, 28.4 percent of the high schools had science facilities which, on the whole, were rated good; 36.5 percent were rated fair; and 35.1 percent, poor.

Large high schools on the whole had better facilities than the

TABLE 10B. NUMBER OF SCHOOLS IN WHICH RATINGS WERE ASSIGNED TO CERTAIN SCIENCE TEACHING FACILITIES

Items		Size of School				
		1-199	200-499	500-999	1000-up	Totals
Science facilities on the whole were:	good	53	75	61	54	243
	fair	132	110	44	26	312
	poor	194	72	24	10	300
Lab. space per student was:	excessive	2	2	1	1	6
	adequate	146	122	74	50	392
	inadequate	231	133	54	39	457
Community resources - field trips - were used:						
	frequently	20	19	7	4	50
	moderately	155	111	46	30	342
	rarely	143	93	55	43	334
	never	61	34	21	13	129

small schools.

Laboratory space per student was inadequate in a few more than one-half of the high schools. Laboratory congestion was more prevalent in the small schools than in the large ones.

Utilization of community resources was quite consistent in all of the high schools. Forty-five and eight-tenths percent of the schools had science teachers who used moderately and/or frequently this off-campus facility, but it was rarely or never used by science teachers in 54.2 percent of the schools.

Summary on science teaching facilities. In the 855 high schools, there were 1988 rooms used for science instruction. The average number of

such rooms per school in the several enrollment categories was: 1-199, 1.2 rooms; 200-499, 2 rooms; 500-999, 3.3 rooms; and 1000-up, 6.8 rooms.

The most prevalent types of rooms used by high school science teachers were combination classrooms and laboratories (multipurpose rooms) equipped for teaching one science subject and combination classrooms and laboratories (multipurpose rooms) equipped for teaching two or more science subjects. In approximately one-fifth of the schools, science was taught in regular classrooms. Separate classrooms and laboratories designed for teaching a single science subject and regular classrooms equipped with movable lecture-demonstration tables were found least frequently.

Small high schools tended to use more combination classrooms and laboratories (multipurpose rooms) equipped for teaching two or more science subjects, while the large schools tended to use more combination classrooms and laboratories (multipurpose rooms) equipped for teaching a single science subject.

Ninety percent or more of the high schools had the following presentation facilities in their science classrooms: chalkboards, A.C. electrical outlets, picture projection equipment, running water, bulletin boards, lecture-demonstration desk, and gas outlets. Fewer than 30 percent of the schools had science rooms containing elevated seating or elevated lecture-demonstration desks, D.C. electrical outlets, and compressed air outlets.

Seventy to ninety percent of the high schools had the following science facilities in their laboratories: A.C. electrical outlets, storage cupboards, gas outlets on each desk, running water and a sink or trough on each table or desk, separate storage-supply rooms, and student equipment lockers. Fifty to seventy percent had window and wall shelves, running

water in laboratories but not on each desk or table, reagent and/or storage shelves, and fume hoods. D.C. electrical outlets and compressed air outlets were available in laboratories of less than 25 percent of the schools.

Large high schools as a group had better presentation and laboratory facilities than the small schools.

In the above summarization, items were listed in the order of their decreasing availability.

An evaluation of science teaching facilities, made by each visitor following consultation with science teachers and administrators, showed that most of the high schools had adequate lighting and ventilation in science classrooms and laboratories. Stockroom storage facilities were adequate in 65 percent of the schools. Laboratory space per student was adequate in only 46.6 percent of the schools.

The location of science classrooms and laboratories was such that minor enlargement and modernization were feasible in 45.5 percent of the high schools.

The overall rating of science teaching facilities, compiled by the state committees at their final meetings, was: good for 28.4 percent of the schools; fair for 36.5 percent; and poor for 35.1 percent.

FINDINGS ON GENERAL PROVISIONS FOR SCIENCE EQUIPMENT

Data pertinent to this category were analyzed with respect to budgetary and procurement practices for science equipment and supplies, sources of funds and equipment other than those associated with regular school channels, and general observations on science equipment.

In this study, when the word equipment or supplies appear, equipment refers to items which can be used over and over again, such as a graduated cylinder, calorimeter, and a microscope; while supplies are consumable items, such as chemicals and earthworms.

Budgetary and procurement practices. Certain data relating to high school science equipment budgets and practices are given in Table 11.

The compiled data in this table reveal that an annual budget for equipment was provided in 58.9 percent of the 855 high schools. For the 1958-59 school year, total funds thus budgeted were $451,358.00. Since 503 schools had such budgets, the average amount of money available for science equipment per school was approximately $900.00. Fifty-one and three-tenths percent of these schools indicated that the amounts of their 1958-59 funds represented an increase over the preceding year, and 32.8 percent pointed out that their allotments were the same as for the previous year. The 1958-59 budgets for the remaining 15.9 percent were below those of 1957-58.

By applying the same analysis to data relevant to annual budgets for science supplies, it was noted that: 443 high schools or 51.9 percent had budgets; funds totaled $169,488.00; and amount per school was about $382.00. The amount of the 1958-59 allotments represented: an increase for 39 percent; no change for 49 percent; and a decrease for 12 percent

TABLE 11. NUMBER OF SCHOOLS IN WHICH CERTAIN PROVISIONS FOR SCIENCE EQUIPMENT WERE NOTED

Items	Size of School				
	1-199	200-499	500-999	1000-up	Totals
Annual budget for purchase of equipment	191	153	86	73	503
1958-59 total allotments for equipment	$83693	$115953	$109418	$142294	$451358
Compared with 1957-58, these amounts represent:					
Increases	90	78	47	43	258
Decreases	28	24	18	10	80
No change	73	51	21	20	165
Annual budget for purchase of supplies	176	133	69	65	443
1958-59 total allotments for supplies	$27454	$35838	$34658	$71538	$169488
Compared with 1957-58, these amounts represent:					
Increases	66	39	33	35	173
Decreases	21	16	11	5	53
No change	89	78	25	25	217
Inventory of equipment and supplies maintained	175	140	79	53	447
Students pay laboratory fees	49	41	30	32	152
Students deposit funds for breakage	48	48	32	29	157

when compared with those for the preceding year.

Members of the state committee who visited the high schools disclosed that schools in the sample not having budgets for science equipment and supplies used funds from other allotments to provide some of the needed

items. Because of a lack of detailed records, it was impracticable to attempt to identify amounts thus expended.

Science equipment budgets were provided by 81 percent of the high schools in the 1000-up size group; by 66.7 percent in the 500-999 group; by 59.5 percent in the 200-499 group; and by 50.4 percent of the schools enrolling less than 200 students. The average amount budgeted per school in each size group was: $1950.00, $1270.00, $757.00, and $438.00 respectively.

Similar data for supply budgets were: 1000-up, 72.2 percent; 500-999, 53.5 percent; 200-499, 51.7 percent; and 1-199, 46.4 percent. The average amount budgeted per school was: $1100.00, $520.00, $270.00, and $156.00 respectively.

Inasmuch as there were 233,544 students enrolled in science classes in the 855 high schools, the average amount of budgeted funds per science student was $2.66 ($451,358 + 169,488 divided by 233,544). Furthermore, a similar breakdown of budgeted funds for the various enrollment categories revealed that the average amount per science student in the 1-199 size group was $3.90; 200-499, $2.88; 500-999, $2.50; and 1000-up, $2.26.

Inventories of equipment and supplies were maintained by 52.3 percent of the high schools. Students enrolled in science classes were required to pay laboratory fees in 17.8 percent of the schools, and 18.3 percent of them collected breakage deposits.

Table 12 shows the systems used by the high schools for procurement of science equipment.

According to the data in Table 12, more orders for science equipment were processed by superintendents and central purchasing agencies than by any of the other listed methods. In almost one out of every 10 high

schools, science department heads ordered for the science teachers, and about one in nine required teachers to pool their orders, which were then submitted to supply houses for bids. In 19.7 percent of the schools, the principal placed orders for the science teachers.

One high school out of every six permitted science teachers to order directly from supply houses, while only one in 50 had a contract with one specific supplier.

TABLE 12. NUMBER OF SCHOOLS USING VARIOUS PLANS FOR PURCHASING SCIENCE EQUIPMENT

Plans	Size of School				
	1-199	200-499	500-999	1000-up	Totals
All orders are pooled and bids obtained	25	21	18	16	80
Contract made with one supplier	10	6	3	1	20
Each teacher orders directly from supply houses	62	43	25	5	135
Orders processed through central purchasing agency	46	44	39	57	186
Principal orders for the teachers	97	45	21	5	168
Science Dept. Head orders for the teachers	19	18	19	28	84
Superintendent orders for the teachers	180	116	40	10	346

There was a tendency for the large schools to process orders through central purchasing agencies, while in the small schools the principal and superintendent assumed major responsibility for the purchase of equipment.

The totals of any one column in Tables 12, 13, and 14 might exceed

(5) because any specific high school could have utilized two or more of the items.

Other sources of funds and equipment. Information regarding auxiliary sources of funds for science equipment is compiled in Table 13.

TABLE 13. NUMBER OF SCHOOLS RECEIVING FUNDS FOR PURCHASING SCIENCE EQUIPMENT FROM THE LISTED SOURCES

Sources	Size of School				
	1-199	200-499	500-999	1000-up	Totals
Admissions to exhibits and science fairs	4	2	0	1	7
Interested parent or citizen	9	9	9	4	31
Local industry	8	9	8	4	29
Local scientific society	5	1	0	0	6
Local service club	8	5	6	3	22
Parent-Teacher Association	32	20	6	5	63
School benefit program or party	11	7	3	5	26

An analysis of these data shows that 7.6 percent of the schools received funds for the purchase of science equipment from Parent-Teacher Associations, and 3.3 percent received such funds from school benefit programs or parties. Furthermore, about 3.5 percent of the schools were recipients of funds from both a local industry and an interested parent or citizen. A local service club contributed funds to 2.6 percent of the schools. Less than one percent of the schools received funds from a local scientific society.

Since such a small number of high schools received funds from

outside sources for the purchase of science equipment, a comparison between its use and school size was hardly feasible.

The tabulation of data pertaining to borrowed and donated equipment is given in Table 14.

TABLE 14. NUMBER OF SCHOOLS RECEIVING BORROWED AND DONATED EQUIPMENT FROM THE LISTED SOURCES

Sources	Size of School				
	1-199	200-499	500-999	1000-up	Totals
Doctor's offices	60	26	12	2	70
Filling stations	23	12	4	0	39
Garages	29	10	2	3	39
Government surplus property programs	33	27	13	4	247
Hospitals	3	3	13	6	27
Industry	28	31	27	20	106
Institutions of higher learning	26	20	20	8	74
Professional societies	11	10	4	2	27
Stores	14	6	6	4	30

Interpretation of these data discloses that approximately three-tenths of the high schools obtained science equipment from the government surplus property program. Industry, institutions of higher learning, and doctor's offices loaned or donated equipment to 12.6, 8.7, and 8.4 percent respectively of the schools. Furthermore, garages and filling stations furnished some equipment to 6.9 and 4.6 percent respectively of the schools. Professional societies, hospitals, and stores were minor sources of borrowed equipment.

So few high schools were using borrowed or donated equipment that a relationship between school size and its use was hardly discernible.

General observations on science equipment. Data pertaining to certain time allotments are shown in Table 15.

TABLE 15. NUMBER OF SCHOOLS IN WHICH SCIENCE TEACHERS WERE ALLOWED TIME FOR MAINTENANCE OF EQUIPMENT AND PREPARING FOR DEMONSTRATIONS AND LABORATORY WORK

Weekly Time Allotment		Size of School				
		1-199	200-499	500-999	1000-up	Totals
Number of hours allowed for maintenance of equipment was:	None	309	209	105	77	700
	One	85	15	11	4	55
	Two	19	11	7	4	41
	Three	9	8	2	0	19
	Four or more	17	14	4	5	40
Number of hours allowed for preparing for lab. & dem.work was:	None	255	163	94	53	565
	One	40	19	9	6	74
	Two	22	13	6	6	49
	Three	22	13	6	6	49
	Four or more	42	41	13	11	127

Only 18.1 percent of the high schools allowed time to their science teachers for maintenance of equipment. Six and four-tenths percent of them allotted one hour per week; 4.8 percent, two hours per week; 2.2 percent, three hours; and 4.7 percent, four hours.

In about one-third of the high schools, science teachers were allotted time for setting up equipment for demonstrations and laboratory work. Thirteen and seven-tenths percent of the schools set aside four or more hours per week for this purpose, while 3.7 percent of them set aside three hours per week; 5.9 percent, two hours; and 8.6 percent, one hour.

Size of the school did not seem significant as a factor in allotting time for preparing laboratory and demonstration work.

Some general observations on science equipment are shown in Tables 16A and 16B.

TABLE 16A. NUMBER OF SCHOOLS ABOUT WHICH CERTAIN OBSERVATIONS ON SCIENCE EQUIPMENT WERE RECORDED

Items		Size of School				
		1-199	200-499	500-999	1000-up	Totals
Lab. and dem. equipment was:	All out-dated.	31	10	00	0	47
	All fairly new.	84	86	47	24	241
	More out-dated than new.	150	76	31	16	273
	More new than out-dated.	106	83	49	48	286
Lab. and dem. equipment was:	Well maintained.	191	170	99	76	536
	Indifferently maintained.	99	58	31	7	195
	Poorly maintained.	80	89	9	7	135
Improvised equipment was utilized:	Frequently	71	54	31	10	156
	Moderately	150	89	59	35	333
	Rarely	91	66	30	33	220
	Never	65	40	17	9	129

An examination of data in Table 16A reveals that 28.2 percent of the high schools had laboratory and demonstration equipment which was all fairly new, while 32.9 percent had equipment which was more new than out-dated. Moreover, one-third of the schools had equipment which was more out-dated than new, and only 5.5 percent had equipment which was all out-dated.

Laboratory and demonstration equipment was well maintained in 62.7 percent of the high schools, indifferently maintained in 21.6 percent of the schools, and poorly maintained in 15.7 percent of the schools.

Improvised equipment was used to a considerable extent in 57.7 percent of the high schools. School size was not a significant factor in the utilization of this type of equipment.

According to the data in Table 16B, equipment for teaching biology was good in 18.4 percent of the high schools; fair in 37 percent; and poor in 44.6 percent. Equipment for teaching chemistry was good in 33.6 percent of the schools; fair in 34.9 percent; and poor in 31.5 percent. For physics, the equipment was good in 19.6 percent of the schools; fair in 29.2 percent; and poor in 51.2 percent.

Supplies for teaching biology were good in 27.6 percent of the high schools; fair in 30.4 percent; and poor in 42 percent. For chemistry, supplies were good in 44 percent of the schools; fair in 30.7 percent; and poor in 25.3 percent.

Equipment and supplies for teaching general science were good in 21.4 percent of the high schools; fair in 34.3 percent; and poor in 44.3 percent.

There was a noticeable relationship between the size of high schools and adequacy of their science supplies and equipment. An analysis of the

TABLE 168. NUMBER OF SCHOOLS IN WHICH RATINGS WERE ASSIGNED TO GENERAL EQUIPMENT AND SUPPLIES FOR TEACHING BIOLOGY, CHEMISTRY, PHYSICS, AND GENERAL SCIENCE

Items		Size of School				
		1-199	200-499	500-999	1000-up	Totals
Equipment for teaching biology was:	Good	30	28	45	54	157
	Fair	121	113	55	27	316
	Poor	228	116	29	9	382
Supplies for teaching biology were:	Good	64	59	47	66	236
	Fair	108	85	31	16	260
	Poor	207	113	31	8	359
Equipment for teaching chemistry was:	Good	68	92	65	63	288
	Fair	154	114	44	16	328
	Poor	187	51	20	11	269
Supplies for teaching chemistry were:	Good	98	120	79	70	376
	Fair	145	89	31	15	280
	Poor	136	39	19	5	199
Equipment for teaching physics was:	Good	85	45	46	32	168
	Fair	95	105	49	20	269
	Poor	275	118	34	16	453
Equipment and supplies for teaching general science were:	Good	44	60	40	39	183
	Fair	135	93	45	20	293
	Poor	200	104	44	31	379

ratings assigned equipment for teaching biology disclosed that in the 1-199

enrollment category, 60 percent of the schools had poor equipment. Similar data for the other enrollment categories were: 200-499, 45 percent; 500-999, 22 percent; and 1000-up, 10 percent. Corresponding data on science supplies showed a drop in poor ratings from 55 percent to nine percent as school size increased. A similar pattern of poor ratings with corresponding increases in fair and good ratings for the other science areas was readily discernible.

Summary on general provisions for science equipment. Fifty-eight and nine-tenths percent of the 855 high schools had specific annual budgets for procuring science equipment. For the 1958-59 school year, the total funds provided by these budgets were $451,358.00. Since 503 schools had budgets, the average amount of money available per school was almost $900.00. In comparing these allotments with those for the preceding year, it was found that they represented an increase for 51.3 percent of the schools; no change for 32.8 percent; and a decrease for 15.9 percent.

Annual budgets for science supplies were found in 443 or 51.9 percent of the high schools. These funds totaled $169,488.00, so the average per school was $380.00. When compared with the amounts budgeted for 1957-58, these allotments represented an increase for 32 percent; no change for 49 percent; and a decrease for 19 percent of the schools.

Some variance in budgetary practices was discernible in high schools of various sizes. Fifty and four-tenths percent of the schools enrolling fewer than 200 students had science equipment budgets which averaged $438.00 per school. Analogous data for the other size categories were: 200-499, 59.5 percent had budgets and the average amount per school was $737.00; 500-999, 66.7 percent and $1270.00; and 1000-up, 81 percent and $1950.00.

Similar interpretation of data on science supply budgets showed

that 46.4 percent of the high schools in the 1-199 enrollment category had them. They averaged $156.00 per school. Analogous data for the other size categories were: 200-499, 51.7 percent had budgets which averaged $270.00; 500-999, 53.5 percent and $520.00; and 1000-up, 72.2 percent and $1100.00.

Both the amount allocated and the percent of schools having budgets for equipment and supplies increased as school size increased.

High schools not having budgets earmarked for science used funds from other allotments to purchase some science equipment and supplies. Accurate estimates of the amounts thus spent were so fragmentary that it was impracticable to consider them.

By combining all budgeted funds for high school science equipment and supplies and dividing the sum by the total number of students enrolled in all science classes, it was found that an average of $2.66 per science student was thus available ($620,846 divided by 233,344). A further breakdown of funds according to school size showed that in the 1-199 enrollment category, the average allotment per science student was $3.90; 200-499, the average was $2.88; 500-999, it was $2.30; and 1000-up, $2.26.

Fifty-two and three-tenths percent of the high schools kept inventories of science supplies and equipment. Students enrolled in science classes were required to pay laboratory fees in 17.8 percent of the schools, and 18.3 percent of them collected breakage deposits.

The most frequently used procedures for purchasing science equipment were to place orders with school superintendents and central purchasing agencies which in turn consummated the transactions. Nine and four-tenths percent of the high schools required that all orders be posted and then submitted for competitive bids; and 15.8 percent permitted science teachers to order directly from supply houses.

Funds for the purchase of science equipment from out-of-school sources, while not abundant, had some significance. Seven and six-tenths percent of the high schools received such funds from Parent-Teacher Associations, and almost 3.4 percent received money from interested parents or citizens, local industry, and school benefit programs and parties. Other minor sources of funds, listed in the order of their decreasing frequencies, were: local service clubs; admission receipts from exhibits and science fairs; and local scientific societies.

The use of borrowed and donated equipment was relatively limited. Twenty-eight and nine-tenths percent of the high schools, however, had obtained science equipment from the Federal Surplus Property program. Some minor sources, listed in the order of their decreasing frequencies, were: local industry; colleges and universities; doctor's offices; garages; filling stations; stores, hospitals; and professional societies.

Since a relatively small number of high schools were recipients of donated and borrowed equipment or funds from out-of-school sources for purchasing equipment, a comparison between their use and school size was hardly feasible.

Fifty-seven and seven-tenths percent of the high schools made extensive use of improvised equipment.

Roughly one-third of the high schools completed time in the science teacher's schedule for setting-up equipment and preparing for laboratory and demonstration work.

An evaluation of science equipment was made by each high school visitor following consultation with science teachers and administrators. These evaluations showed that about two-fifths of the high schools had equipment which was either all fairly new or was more new than out-dated,

and that it was well maintained even though only 18.1 percent of the schools allocated time in the science teacher's schedule for maintenance and care of equipment.

The overall ratings of science equipment showed that chemistry equipment was judged best, general science second, biology third, and physics poorest. In terms of good, fair, and poor, chemistry was rated fair plus; general science, fair; biology, fair minus; and physics, poor.

FINDINGS PERTINENT TO QUANTITY OF EQUIPMENT

Data in the equipment inventories were utilized to determine the number of each item available per school, per classroom - when significant, and the number of science students per item. A comparison of these ratios with the recommendations presented in the Purchase Guide for Programs in Science, Mathematics, and Modern Foreign Languages (3) may be used as a basis for further study and interpretation. Moreover, the portion of high schools not having certain items of science equipment and the number of science students in these schools was determined.

The items in each inventory do not represent necessarily the minimum or optimum quantity of equipment for any of the science subjects. The lists were prepared to serve only as guides for inventory and tabulation purposes. They are not mutually exclusive; some items can be used in teaching more than one science subject. Most of the items listed, however, can be found in the basic and standard lists in the purchase guide.

In order to avoid repetitious discussions, data on one key item of equipment in each inventory list were used to illustrate the interpretive steps. These techniques can be applied in a similar manner to any of the other items listed in Tables 17 through 21.

General science equipment. Data on science offerings and enrollment were tabulated in Tables 3 and 4. An examination of these data discloses that the average number of general science students per high school and the number of class sections in which they enrolled, categorized by school size groups, were: 1-199, 34 students in 1.4 sections; 200-499, 83 in 3; 500-999, 166 in 5.7; and 1000-up, 346 in 11.7. These statistics were used for interpreting data in Table 17. Analyses of data for each enrollment

TABLE 17. NUMBER OF HIGH SCHOOLS IN WHICH THE LISTED ITEMS OF EQUIPMENT WERE PRESENT, AND THE QUANTITY OF EACH ITEM AVAILABLE IN THE SCHOOLS, CLASSIFIED BY SIZE OF SCHOOL

Name of Items	Status of Equipment by Size of School									
	(379) 1-199		(257) 200-499		(129) 500-999		(90) 1000-up		(855) Totals	
	P	N	P	N	P	N	P	N	P	N
1. Altimeter, dial face	37	37	30	32	20	24	22	26	109	119
2. Anemometer, weather	40	42	47	49	31	31	31	34	149	156
3. Aquarium	207	259	153	217	56	83	45	128	461	687
4. Binoculars	35	49	21	36	15	27	3	3	74	115
Charts:										
5. Acoustic	38	44	38	38	21	23	16	30	113	135
6. Astronomy	71	72	52	54	36	50	36	80	195	256
7. Atomic structure	124	128	91	97	43	54	30	56	288	335
8. Atomic weight	188	192	122	131	53	60	41	79	404	462
9. Barometric	38	38	34	34	17	21	13	26	102	119
10. Electrochemical	70	70	46	46	24	26	21	28	161	170
11. Radiation, electro-magnetic	44	45	61	62	35	37	32	40	172	184
12. Periodic	259	266	177	193	75	82	51	92	562	633
13. Vision	140	146	90	94	45	46	31	49	306	335
14. Chime, electric	102	164	58	111	32	78	16	43	208	396
15. Constant level tubes	114	125	90	115	48	67	40	59	292	366
16. Dew point apparatus, Millikan's	87	113	82	107	42	81	37	78	248	379
17. Globe, celestial	45	47	29	30	20	20	26	34	120	131
18. Globe, Hall Tellurian, longitude & latitude	50	52	26	30	20	21	32	42	128	145
19. Globe, terrestrial	150	175	98	111	47	52	43	75	338	413
20. Gyroscope, bicycle wheel and handles	65	71	53	55	29	32	31	35	178	193
21. Hygrometer, aneroid	80	86	81	87	42	48	38	61	241	282
22. Hygrometer, sling	42	45	64	75	40	48	36	52	182	220
23. Hygrometer, wet & dry	158	159	124	138	62	67	59	92	403	456

TABLE 17 (continued)

24. Map, geological	55	69	27	41	12	12	16	25	110	147
25. Map, hemispherical	65	65	24	27	11	11	17	21	117	124
26. Model, airplane	21	41	31	52	19	34	15	30	86	157
27. Models, engines, assortment	155	200	133	207	68	98	55	130	411	635
28. Planetarium, Spitz with canopy	6	7	9	9	9	9	10	10	34	35
29. Planetarium, mechanical, solar system	32	32	36	38	31	31	25	36	126	137
30. Rain gauge	50	52	33	45	28	33	31	51	142	181
31. Still, water	66	71	49	53	26	27	31	34	172	185
32. Telescope, refract.	23	24	17	19	14	23	12	13	66	79
33. Telescope, reflect.	9	11	14	15	9	9	11	12	43	47

Note: Numbers in parentheses at the top of each column in Table 17 indicate the total number of high schools in each enrollment category. These will apply in all subsequent tables, but will not be repeated. Letters "P" and "N" are abbreviations for present and number respectively.

The number of schools in which the items were absent can be determined by subtracting the numbers in the "P" columns from the total number of schools in the applicable enrollment categories (numbers in parentheses); i.e., 37 schools in the 1-199 size group had an altimeter. Since there were 379 schools in this enrollment category, this instrument was absent in 342 of them (379 minus 37).

category were made separately.

Schools in the 1-199 size group. According to Table 17, 139 wet and dry bulb hygrometers were present in 138 of the high schools. This was an average of 1.0 hygrometer per school (139 divided by 138). It follows, therefore, that in these schools there was an average of 34 students per hygrometer (gross) (34 divided by 1.0). Inasmuch as there was an average of 1.4 class sections of general science in each of these schools, perhaps a more meaningful comparison between the number of students per hygrometer would be 24 to 1 (net) (34 divided by 1.4).

Since there were six or more class periods in the usual school day, the 1.4 class sections of general science could have met in the same room. If this were done, there was one wet and dry bulb hygrometer per classroom.

On the other hand, this item of equipment was absent in 221 or 58.3 percent of the high schools. General science was offered, however, in only 15% (379 minus 138; remainder from 221) of the schools. Thus, an equivalent of 5,316 (34 times 156) general science students were deprived of firsthand classroom experiences with a wet and dry bulb hygrometer.

Schools in the other size groups. Analogous statistics on wet and dry bulb hygrometers for the schools in these size groups are given in the following tabulation. For comparison, the figures from above are tabulated in the 1-199 column.

An analysis of these statistics reveals that as the size of the high schools increased, the average number of wet and dry bulb hygrometers per school also increased; so did the gross number of students per hygrometer. On the other hand, the net number of students per hygrometer was the lowest in the largest schools. There was approximately one hygrometer per classroom in each school size group.

Type of Analysis (averages)	Size of School 1-199	200-499	500-999	1000-up	Mean
1. Number per school	1.0	1.1	1.1	1.4	1.2
2. Number of general science students per school	34	83	166	346	142
3. Number of students per item (gross)	34	73	151	246	119
4. Number of students per item (net)	34	83	86.3	18.6	83.3
5. Percent of schools not having item	58.3	51.8	52.0	34.4	49.1
6. Number of students involved in #5	3,516	9,462	8,470	1,038	24,502 (Total)
7. Number of item in each classroom	1.0	1.1	1.1	0.8*	1.0

* Eleven and seven-tenths sections of general science met probably in ten classrooms. Since there was an average of 1.6 hygrometers per school, each general science room had the equivalent of 0.8 instruments per room.

Wet and dry bulb hygrometers were absent in a higher percent of the small high schools than in the large ones. Moreover, the number of students deprived of contact with this instrument decreased substantially as school size increased. About one-third of the general science students were in schools or rooms not having a hygrometer.

Biology equipment. Data on science offerings and enrollment were tabulated in Tables 3 and 4. An analysis of these data reveals that the average number of biology students per high school and the number of class sections in which they enrolled, categorized by size of school, were: 1-199, 30 students in 1.4 sections; 200-499, 76 in 2.8; 500-999, 173 in 6.4; and 1000-up, 432 in 14.9. These statistics were used for interpreting data in Table 18. Analyses of data for each enrollment category were made separately.

Schools in the 200-499 size group. According to Table 18, 939 student microscopes were present in 205 of the high schools. This was an average of 4.5 microscopes per school (939 divided by 205). It follows,

TABLE 18. NUMBER OF HIGH SCHOOLS IN WHICH THE LISTED ITEMS OF EQUIPMENT WERE PURCHASED, AND THE QUANTITY OF EACH ITEM AVAILABLE IN THE SCHOOLS, CLASSIFIED BY SIZE OF SCHOOL

Name of Items	Status of Equipment by Size of School									
	1-199		200-499		500-999		1000-up		Totals	
	P	N	P	N	P	N	P	N	P	N
Student Locker Equipment										
1. Bladder	104	815	84	836	44	666	30	602	262	9119
2. Scapel	257	2918	185	2896	102	1731	66	2070	610	9615
3. Forceps	253	2604	186	2384	103	1850	67	2503	609	9341
4. Needles	250	2984	188	2714	102	2536	67	3337	607	11571
5. Scissors	252	2418	187	2307	103	1933	67	2486	609	9088
6. Dissection pans waxed lined	242	2618	197	2733	105	1946	67	2222	618	9519
7. Magnifiers, tripod	245	2630	163	1497	100	1239	63	1630	578	7167
8. Medicine dropper	265	3247	174	2405	102	2024	67	2735	608	10411
9. Mounts, specimen	91	1084	67	805	83	822	39	879	280	3510
General Laboratory Equipment										
1. Animal collection	205	2332	145	1599	85	794	48	1387	383	6112
2. Aquarium with livestock	169	231	159	224	102	267	80	435	510	1157
3. Aquarium heater with thermostat	41	48	45	52	53	74	39	162	198	336
4. Balance, platform or beam type	266	686	169	440	86	226	56	211	577	1573
5. Bell jars, assorted	231	474	156	371	81	205	72	361	540	1452
6. Binoculars	38	75	14	26	10	42	14	67	84	210
7. Burner, bunsen type or equivalent	300	2856	191	2179	108	638	81	1027	680	6710
8. Cages, animal	100	175	100	247	88	266	73	477	361	1165
9. Cages, insect	40	52	34	62	43	97	52	224	169	435
10. Centrifuge, electric	34	40	19	20	14	16	16	23	83	99
11. Charts, biological assorted	311	2006	234	1696	119	1003	87	2277	751	6944
12. Cooker, pressure	30	31	20	20	30	30	42	79	122	211

TABLE 10 (continued)

13. Cylinders, graduated	274	2642	177	1589	91	691	76	611	542	3733
14. Gauze, wire	258	2830	143	2046	69	739	63	810	367	6389
15. Hot plate, electric	99	119	55	81	42	56	38	43	234	313
16. Human torso	31	31	39	39	82	96	80	96	248	248
17. Incubator, electric	28	30	38	43	45	59	33	38	184	184
18. Kymograph and acces.	2	2	3	3	3	3	2	2	17	17
19. Lung, artificial	42	42	41	41	34	35	38	46	130	184
20. Microscope, 3 objective, oil immersion lens for instructor's use	74	97	80	133	49	106	42	173	238	393
21. Microscopes, 2 objective, low-high-dry for student use	314	980	203	939	118	1089	85	2016	722	4584
22. Kidney, model	8	8	20	20	20	20	27	29	75	81
23. Ear, model	90	93	94	101	75	81	72	94	325	361
24. Eye, model	101	103	113	116	77	82	73	101	364	402
25. Heart, model	108	108	109	113	73	73	73	110	331	394
26. Brain, model	42	66	50	51	30	32	64	90	186	239
27. Assortment of plant models and their parts	43	279	46	140	49	105	61	1504	183	2028
28. Petri dishes, culture	243	3259	109	3232	109	10846	86	2211	549	11478
29. Polariser	20	23	34	46	23	34	11	11	118	130
30. Slides, blank with over slips - some concave	282	17121	209	16643	117	9771	82	13139	689	55674
31. Slides, microscope, assortment of prepared ones	325	17949	228	16284	119	13944	86	25801	758	69350
32. Terrarium	69	100	84	100	80	126	76	136	309	462
33. Test tube holder	258	2718	130	1349	97	712	69	941	577	6520
34. Tubing, glass (lin)	282	5892	167	4188	85	2032	64	1456	598	13568
35. Tubing, rubber (ft)	285	4821	172	3745	87	1383	79	939	624	11788

TABLE 10 (continued)

36. Spirometer	10	11	7	7	7	7	13	16	37	44
37. Soil testing kit	70	119	70	81	35	44	56	79	257	323
38. Ring stand, assortment of rings, and burette clamp	296	2755	190	1612	105	620	80	827	671	3614
39. Preserved specimens, assortment	257	6479	207	7338	113	4956	80	10789	699	29562
40. Commuter	35	63	35	43	26	31	27	41	123	178
41. Glassware, assortment of beakers, flasks, and test tubes	272	16000	180	9011	101	4526	77	5542	630	34079

therefore, that in these schools there was an average of 16.5 students per microscope (gross) (75 divided by 4.5). Since there was an average of 2.8 class sections of biology in each of these schools, perhaps a more meaningful comparison between the number of students per microscope would be 6 to 1 (net) (16.5 divided by 2.8).

On the other hand, this item of equipment was absent in 92 or 80.2 percent of the high schools. Biology was offered, however, in only 48 (25? minus 23); remainder from 92) of the schools. Thus, an equivalent of 3,600 (75 times 48) biology students were deprived of first-hand classroom experiences with a microscope.

Schools in the other size groups. Analogous statistics on microscopes for the schools in these size groups are given in the following tabulation. For comparison, the figures from above are tabulated in the 200-499 column.

Type of Analysis (Averages)	Size of School 1-199	200-499	500-999	1000-up	Mean
1. Number per school	2.9	4.5	9.2	24.2	10.2
2. Number of biology students per school	30	75	173	432	178
3. Number of students per item (gross)	10	16.5	19	18	15.9
4. Number of students per item (net)	7	6	3	1.8	4.3
5. Percent of schools not having item	17.1	80.2	6.5	5.5	12.8
6. Number of students involved in #5	960	3,600	1,903	1,296	7,767 (Total)

An analysis of these statistics discloses that as the size of the high schools increased, the average number of microscopes per school also increased; so did the gross number of students per microscope except for the slight decrease in the 1000-up enrollment category. On the other hand, the net number of students per microscope was the lowest in the largest schools.

Student microscopes were absent in a higher percent of the small high schools than in the large ones. Except for the smallest schools, the number of students deprived of contact with this instrument increased substantially as school size increased. About one-twelfth of the biology students were in schools not having a microscope.

Chemistry equipment. Data on science offerings and enrollment were tabulated in Tables 3 and 4. The compiled data disclose that the average number of chemistry students per high school and the number of class sections in which they enrolled, categorized by school size groups, were: 1-199, 19 students in 1.1 sections; 200-499, 34 in 1.6; 500-999, 79 in 1.9; and 1000-up, 178 in 3.7. These statistics were used for interpreting data in Table 15. Analyses of data for each enrollment category were made separately.

Schools in the 200-299 size group. According to Table 13, 2,726 graduated cylinders were present in 125 of the high schools. This was an average of 22.5 cylinders per school (2,726 divided by 125). It follows, therefore, that in these schools there was an average of 3.5 students per cylinder (group) (79 divided by 22.5). Inasmuch as there was an average of 1.1 class sections of chemistry in each of these schools, perhaps a more meaningful comparison between the number of students per graduated cylinder would be 1.1 to 1 (set) (3.5 divided by 3.1).

On the other hand, this item of equipment was absent in 8 or 6.2 percent of the high schools. Chemistry was offered, however, in only 5 (1.89 minus 1.26; remainder from 8) of the schools. Thus, an equivalent of 395 (79 times 5) chemistry students were deprived of firsthand classroom experiences with a graduated cylinder.

Schools in the other size groups. Analogous statistics on

TABLE 19. NUMBER OF HIGH SCHOOLS IN WHICH THE LISTED ITEMS OF EQUIPMENT WERE PRESENT, AND THE QUANTITY OF EACH ITEM AVAILABLE IN THE SCHOOLS, CLASSIFIED BY SIZE OF SCHOOL

Name of Item	Status of Equipment by Size of School									
	1-199		200-499		500-999		1000-up		Totals	
	P	S	P	S	P	S	P	S	P	S
Student Locker Equipment										
1. Beakers, assortment	200	7093	826	7707	119	7492	803	97280	7148	319572
2. Blowpipe, 8 inch	183	1013	173	1519	101	1391	73	1273	530	5196
3. Bottles, wide-mouth	269	5712	253	8042	117	7032	78	8787	697	29573
4. Brush, test tube	275	2755	227	3319	121	2816	82	4026	705	12916
5. Burner, bunsen or equivalent	266	2123	232	2750	119	2030	73	2670	690	9573
6. Crucible and cover	243	1843	220	2676	117	2202	73	2731	653	10452
7. Dish, evaporating	263	2226	229	2868	117	2576	84	4779	693	12449
8. File, triangular	237	1137	210	1668	111	1823	64	2440	622	7250
9. Flask, florence	263	3637	227	3104	111	2768	67	3527	668	13136
10. Flask, erlenmeyer	262	3253	211	3433	109	3307	74	4707	656	14700
11. Forceps	236	1595	202	2431	112	2223	77	3338	627	9840
12. Funnel	273	2682	226	2983	120	2920	82	4143	701	12116
13. Gauze, wire	247	2231	226	3238	120	2809	76	3580	669	11958
14. Glass plates and one cobalt plate	235	3619	209	5224	113	6602	74	6813	631	22277
15. Graduated cylinder	248	2319	216	2630	121	2726	82	3892	667	10566
16. Mortar and pestle	244	1373	213	1895	112	1946	67	2831	636	7745
17. Pinchcock - compressor type	187	1417	163	2016	96	1408	59	1322	494	6163
18. Rack, test tube	275	1772	232	2463	122	2051	78	2634	707	8920
19. Rubber stoppers, assortment	248	8526	224	8389	109	9347	67	9210	648	35462
20. Spatula	195	1287	177	1776	101	1762	54	964	527	5789
21. Spoon, deflagrating	220	1316	213	2114	114	1712	63	2706	610	7848
22. Test tubes, assorted	279	17719	233	105302	120	17981	90	17274	722	114476
23. Test tube holder	269	2518	233	3096	120	2629	82	4496	704	12739
24. Thermometers, C & F	225	1316	158	1230	73	845	42	782	503	4173
25. Thistle tube	262	1862	214	2444	108	2477	74	3239	657	10873

TABLE 19 (continued)

26. Tubing, glass (lbs)	227	4426	198	4086	106	2181	69	1893	600	11713
27. Tubing, rubber (ft)	231	3005	198	4349	107	2297	67	2393	602	13128
28. Tongs, crucible	222	1317	193	1847	110	1560	64	2809	589	6833
29. Trough, pneumatic	227	1880	208	1827	112	1206	64	1169	611	7362
30. Triangle, pipe-stem	234	1920	214	2609	114	2317	76	2967	638	9813
31. Watch glasses	243	2671	214	3045	115	3288	79	4404	653	14240
32. Wing-Top for burner	224	1454	207	1906	106	1682	67	1411	604	6933
General Equipment										
1. Balance, analytical	132	132	107	134	77	124	70	2222	324	2650
2. Balance, triple-beam or platform	250	835	236	875	119	7758	86	10894	731	34877
3. Barometer, mercury or aneroid	222	265	191	258	94	132	66	89	573	743
4. Bottles, reagent for laboratory desks	212	4945	179	5606	97	4804	71	3691	739	18506
5. Bottles, reagent for side shelves	239	5439	177	5845	100	4804	73	3752	599	18040
6. Burettes, 50 ml.	265	1405	213	1933	117	1615	86	2827	681	7979
7. Cabinet, first aid	154	159	143	154	96	102	77	91	468	569
8. Clamps, burette	259	2230	203	3003	126	2629	85	3176	663	11128
9. Condensers and clamps	251	1027	214	1352	126	1284	87	1377	668	5077
10. Chart, periodic table	276	286	223	298	110	131	85	101	732	914
11. Chart, electrochemical series	82	87	74	77	66	80	60	85	282	349
12. Conductivity apparatus	149	232	158	251	91	890	76	287	474	1660
13. Cork borer set	214	262	170	262	108	158	82	105	774	867
14. Cork assortment	267	3690	203	3832	105	1702	84	1125	659	10727
15. Cylinders, graduated, assortment	279	1800	208	1595	126	1389	86	1683	689	6415
16. Beakers, assortment	229	2080	180	2866	108	1717	83	1342	598	7343
17. Desiccator with plate	53	67	80	128	66	189	70	294	269	948
18. Electrolysis apparatus	226	322	193	300	113	259	82	260	614	1683
19. Funnels, Buechner's	80	282	80	354	53	254	52	282	265	1112
20. Generator, gas, Kipp	36	49	40	72	43	47	30	109	177	277
21. Hot plate, electric	91	109	62	77	46	59	33	65	233	310

TABLE 19 (continued)

22. Hydrometer, universal	156	342	138	332	85	258	50	253	429	1279
23. Kit, atomic model	33	36	39	45	39	76	45	62	156	219
24. Lamp, blast	25	25	17	29	22	28	26	39	90	121
25. Model, molecular	38	41	46	51	43	61	42	68	169	221
26. Magnifiers, tripod or equivalent	202	1466	150	1248	78	633	66	753	496	4100
27. Oven, drying	21	21	19	21	23	23	32	33	95	100
28. Ozone, generating apparatus	2	2	9	9	10	11	10	22	39	44
29. Pipettes, assortment	214	1341	174	1520	107	1202	81	1392	576	5455
30. Retorts with glass stoppers	221	989	212	1355	109	1004	82	1349	624	4697
31. Ring stands, assortment of rings and burette clamps	315	3405	241	4438	123	3235	87	2835	766	13913
32. Soil testing set	66	103	64	82	26	41	37	58	193	278
33. Spot plates	19	87	27	230	27	198	38	290	111	805
34. Still, water	55	59	61	66	47	82	57	62	220	269
35. Thermometers, assorted	253	1568	196	1764	104	1308	81	1583	634	6223
36. Weights, 10 grams to 1000 grams	284	1123	209	1047	106	697	70	584	669	3451
37. Weights, analytical 50 mg to 10 gms	157	422	136	464	88	327	77	474	458	1687
38. Wire, platinum	178	712	150	936	79	712	65	841	472	3201
Semi-micro laboratory equipment?										
39. Yes	13	-	19	-	17	-	16	-	65	-
40. No	366	-	238	-	112	-	74	-	790	-

graduated cylinders for the schools in these size groups are given in the following tabulation. For comparison, the figures from above are tabulated in the 500-999 column.

Type of Analysis (Averages)	Size of School 1-199	200-499	500-999	1000-up	Mean
1. Number per school	9.3	12.2	22.5	40.0	21.0
2. Number of chemistry students per school	19	34	79	178	77.3
3. Number of students per item (gross)	2	2.8	3.5	4.5	3.2
4. Number of students per item (net)	1.8	1.7	1.1	0.3	1.3
5. Percent of schools not having item	34.6	19.0	6.2	2.2	15.5
6. Number of students involved in #5	0*	578	395	0*	973 (Total)

* The high schools in which graduated cylinders were absent were not offering chemistry during the 1958-59 academic year.

An analysis of these statistics discloses that as the size of the high schools increased, the average number of cylinders per school also increased; so did the gross number of students per graduated cylinder. On the other hand, the net number of students per cylinder was the lowest in the largest schools.

Graduated cylinders were absent in a higher percent of the smaller than in the larger high schools. Moreover, the number of students deprived of contact with this item decreased substantially as school size increased. About one-fortieth of the chemistry students were in schools not having a graduated cylinder.

Physics equipment. Data on science offerings and enrollment were tabulated in Tables 3 and 4. An analysis of these data reveals that the average number of physics students per high school and the number of class sections in which they enrolled, categorized by size of school, were:

TABLE 20. NUMBER OF HIGH SCHOOLS IN WHICH THE LISTED ITEMS OF EQUIPMENT WERE PRESENT, AND THE QUANTITY OF EACH ITEM AVAILABLE IN THE SCHOOLS, CLASSIFIED BY SIZE OF SCHOOL

Name of Items	Status of Equipment by Size of School									
	1-199		200-499		500-999		1000-up		Totals	
	P	N	P	N	P	N	P	N	P	N
1. Air jet attachment for tones	22	22	42	43	36	36	42	60	142	161
2. Ammeter, A.C., 1 amp.	134	191	122	253	76	199	70	318	402	961
3. Ammeter, A.C., 10 amp.	180	289	167	338	94	306	76	355	517	1288
4. Amplifier, Audio-frequency	26	33	33	44	28	31	42	52	129	160
5. Archimedes' Principle apparatus	104	164	104	199	73	197	70	340	351	900
6. Balances, platform	241	568	196	639	103	556	81	929	621	2692
7. Balances, triple-beam	159	291	138	313	78	356	63	464	438	1424
8. Balance, dial-spring, 500 grams	140	665	129	994	83	806	66	1017	418	3482
9. Balance, spring, 250 g	228	1346	180	1557	107	1252	77	1603	592	5758
10. Balls, aluminum, 1"	21	211	81	250	58	294	41	302	261	1057
11. Ball, inertia	94	155	101	219	68	168	62	192	325	734
12. Balls, lead, 1"	99	248	84	246	65	335	56	539	304	1368
13. Balls, wood	136	435	122	580	92	512	67	706	417	2233
14. Balls, bouncing and non-bouncing	30	83	33	110	28	274	32	241	123	708
15. Ball and ring, expan.	243	286	201	255	111	149	85	183	640	873
16. Barometer, aneroid	180	197	156	170	101	117	85	124	522	608
17. Barometer, mercurial	134	136	131	136	91	98	76	107	432	477
18. Barometer, recording barograph	7	7	7	7	11	11	42	46	67	71
19. Battery jar, 1 gallon	203	437	175	512	105	440	79	414	562	1803
20. Battery, storage	93	154	86	198	62	229	46	167	287	748
21. Battery substitute, low A.C. and D.C.	132	159	143	212	73	147	58	150	406	668

TABLE 20 (continued)

22. Bell in vacuo	102	102	134	139	87	89	77	88	400	418
23. Bell jars, assortment	219	439	183	362	101	263	84	330	587	1494
24. Bench, optical	114	261	107	243	77	322	63	419	361	1345
25. Boiler, cryophorous	61	162	78	276	49	175	41	296	229	909
26. Box, resistance, three-dail	125	191	127	268	77	230	68	384	397	1073
27. Boyles's Law apparatus J form	144	216	150	284	95	297	82	289	471	1086
28. Brownian movement apparatus	62	68	74	90	63	80	59	76	258	314
29. Burner, bunsen type	240	2620	198	3257	107	1644	86	1465	631	8986
30. Burner, Fisher type	83	190	92	191	56	142	37	97	268	620
31. Caliper, micrometer	186	309	178	428	104	513	79	732	547	1982
32. Caliper, vernier	186	408	188	598	112	644	82	1041	568	2691
33. Calorimeter	202	595	197	917	106	836	79	1227	584	3575
34. Camera, 35 mm Kodak or equivalent	36	39	44	52	29	29	11	18	120	138
35. Can, overflow	233	774	195	1095	112	1026	84	1267	624	4162
36. Capillary set	182	182	160	208	92	135	76	158	510	683
37. Cartesian diver set	118	137	114	144	74	111	69	103	375	495
38. Centrifugal hoop	99	103	92	95	64	69	62	72	316	339
39. Chart, spectrum	78	81	111	116	74	76	66	80	330	353
40. Clamps, condenser	129	662	117	854	70	577	59	660	375	2753
41. Cell, student	141	567	124	546	91	686	62	899	418	2698
42. Centrifuge, hand type	55	73	65	74	39	44	38	47	207	238
Clamps:										
43. Knife-edge	111	647	117	858	77	829	67	[illegible]4	372	3388
44. Pendulum	100	301	115	385	79	370	65	[illegible]	359	1817
45. Right angle	118	535	110	591	72	720	75	1182	375	3028
46. Meter stick	187	1101	162	1270	94	1080	71	1049	514	4499
47. Swivel	95	438	69	414	48	257	46	364	258	1473
48. Table	130	416	124	480	77	445	70	928	401	2269
49. Tubing	171	1558	147	1759	75	885	72	717	465	4919
50. Lens	130	777	140	1230	87	843	76	1330	433	4180

TABLE 20 (continued)

51. Coils, resistance set of 8	159	238	159	299	94	273	75	566	487	1376
52. Cohesion figures	32	42	50	80	28	43	57	50	147	215
53. Coils, induction	152	250	164	325	95	266	85	384	496	1225
54. Coils, primary and secondary	134	188	136	243	88	228	74	480	432	1139
Compass:										
55. Declination	112	134	110	219	70	207	67	279	359	839
56. Inclination	84	126	97	128	74	132	65	121	320	507
57. Magnetic-jeweled	54	206	62	214	37	214	35	186	188	820
58. Magnetic, small	206	1363	186	1653	97	1112	77	1619	566	5747
59. Conductometer	49	60	71	87	45	64	42	62	207	273
60. Convection box	58	100	64	70	54	68	57	53	233	311
61. Cord, extension	214	394	159	402	93	359	74	373	540	1528
62. Cord, linen for pulley	133	1174	123	1695	77	1174	68	852	401	4895
63. Double cone and plane	49	57	78	82	46	54	57	77	230	269
64. Drawing compasses	87	523	75	459	53	576	62	1043	276	2601
65. Disk, siren & color	167	197	165	210	95	109	80	171	507	687
66. Dynamo, hand powered, demonstration	94	109	118	146	80	110	70	97	362	462
67. Electromagnet	164	233	148	295	97	244	84	313	493	1085
68. Electromagnet attachment	59	74	57	97	49	142	57	258	222	571
69. Electrophorus	105	155	121	176	85	138	78	191	389	660
70. Electroscope, met.leaf	199	340	185	408	110	306	87	422	581	1476
71. Electroscope, pith ball	159	238	149	266	87	160	72	325	467	989
72. Electrostatic demonstration set	111	130	129	165	82	114	67	102	389	511
73. Engines, working models, assortment	172	172	128	161	75	111	70	150	445	594
74. Files, triangular & flat	228	1419	179	1873	92	983	71	333	570	4608
75. Filmloops, radioactive	6	16	11	11	6	15	7	7	28	49

TABLE 20 (continued)

76. Filings, iron	289	597	206	615	115	408	87	658	697	2278
77. Force board	128	212	148	371	91	374	72	503	439	1460
78. Fur, half cat skin	179	218	174	228	101	190	80	272	534	904
79. Fluoroscope, demonstration type	12	17	19	25	26	27	39	43	96	112
80. Gear train	34	36	40	41	39	45	59	81	171	203
81. Galvanometer, lecture table model	132	174	42	269	87	153	79	151	440	747
82. Geiger counter	41	66	89	167	81	174	69	128	279	535
83. Geissler tubes	74	146	88	149	68	101	66	165	296	561
84. Generator, steam	137	326	115	384	76	401	60	575	388	1686
85. Generator, magneto-electric, hand operated	95	111	116	197	79	112	64	104	354	524
86. Glassware, assorted	225	5473	165	4275	96	1494	81	1667	567	12909
87. Glass, pulse	61	64	66	71	52	67	59	80	238	282
88. German silver wire #22	87	250	86	379	67	310	65	339	305	1278
89. Gyroscope	116	135	128	152	71	82	73	95	378	464
90. Hall's Carriage	141	536	143	462	86	453	69	777	439	2028
91. Hangers, weight	167	198	156	909	96	750	75	754	494	3011
92. Hooke's Law apparatus	155	342	153	479	94	451	77	588	480	1860
93. Hooke's Law spring	127	340	116	389	83	376	70	493	397	1598
94. Hydrometer, heavy liquid	177	282	161	311	112	367	79	437	529	1397
95. Hydrometer jar	119	280	120	403	86	376	66	655	391	1714
96. Hydrometer, battery	108	140	109	210	65	100	67	157	349	607
97. Hygrometer	122	160	132	184	89	137	69	183	412	664
98. Inclined plane	226	395	205	450	116	523	85	766	632	2134
99. Jar, bell	219	405	177	421	100	262	79	288	270	1376
100. Knife	162	284	120	239	72	134	57	85	411	742
101. Lamp, ultraviolet	47	56	72	92	58	72	68	86	245	306
102. Lamps, screw base	142	799	140	952	85	758	74	1302	441	3811

TABLE 20 (continued)

103. Lamp, carbon arc	33	43	55	62	53	63	58	81	199	249
104. Lamp socket assembly for series and parallel circuits	162	238	169	257	95	214	79	325	505	1034
105. Lens, assortment	235	1278	195	1340	113	789	82	1085	625	4492
106. Lenses, spherical	78	216	85	486	54	327	47	631	264	1660
107. Lead sinkers	105	442	98	511	75	553	56	714	334	2219
108. Leyden jars	174	312	168	343	96	243	84	248	522	1146
109. Linear expansion apparatus	180	308	177	442	106	396	75	602	542	1748
110. Liter case	83	83	43	43	26	26	39	71	191	223
111. Liquid set, fluorescent	20	20	35	36	24	24	29	30	108	110
112. Lever demonstration apparatus	134	346	122	352	83	354	68	703	407	1755
113. Lodestone	116	151	110	160	68	114	60	113	354	538
114. Magdeburg hemispheres	170	187	179	215	98	125	83	136	530	663
115. Magnet, Alnico	80	178	99	344	85	280	69	337	333	1139
116. Magnet, U	282	1133	217	1118	115	718	86	818	700	3787
117. Magnets, bar	293	1997	217	2223	121	1781	86	1883	717	7584
118. Magnets, assorted	132	642	109	726	65	379	62	608	368	2355
119. Metal, assorted strips	189	1585	163	1996	100	1509	79	2185	531	7275
120. Meter sticks	279	1814	117	2184	119	1673	86	1837	701	7508
121. Meter stick, four scale	39	154	33	190	19	119	17	230	108	693
122. Meter, foot candle	56	68	70	92	52	71	59	146	237	377
123. Metronome	31	33	30	32	28	28	54	61	143	154
124. Mirror, spherical	96	208	128	431	90	332	76	509	390	1480
125. Motor, St. Louis	181	335	154	392	101	454	81	589	517	1770
126. Model vernier	22	22	59	74	59	63	48	53	188	212
127. Model engine, gasoline, cross-section	61	64	60	61	54	57	50	55	225	237

TABLE 20 (continued)

128. Model engine, diesel, cross-section	7	7	9	9	9	9	9	10	34	35
129. Microphones, crystal and carbon	68	117	67	124	40	76	54	108	228	425
130. Needle, magnetic	112	211	97	253	79	250	64	413	352	1127
131. Oerstad's Law apparatus	41	61	47	65	42	77	44	110	174	313
132. Object holders for meter sticks	170	913	50	1163	91	878	67	1279	478	4233
133. Optical disk with accessories	114	124	118	122	81	100	70	81	383	427
134. Organ pipe with sliding piston	57	63	61	84	49	66	60	81	227	294
135. Osmosis apparatus	103	137	83	121	55	79	49	65	290	402
136. Pascal's vases	73	79	101	113	64	74	61	72	299	338
137. Pendulum	108	199	113	267	77	258	68	379	366	1103
138. Prism, equilateral	237	816	183	712	103	518	84	706	607	2752
139. Proof plane	53	87	80	139	65	131	72	251	270	608
140. Protractors	123	642	93	681	68	973	70	1293	354	3589
141. Photoelectric cell and relay	50	59	82	91	62	68	66	87	260	305
142. Photometer, bunsen	108	208	124	282	87	305	77	319	396	1114
143. Physics charts	109	577	113	485	70	301	66	565	358	1928
144. Plate, index of ref.	95	273	106	484	82	608	68	1107	351	2472
145. Polaroid kit	90	95	117	136	82	111	77	135	366	477
146. Power unit, electric 110 A.C., variable A.C. & D.C. output	113	160	141	200	68	107	61	136	383	603
147. Pulleys, assorted	299	2665	217	2798	123	2039	87	2752	726	10254
Pumps:										
148. Air	185	220	130	146	83	96	64	83	462	545
149. Force model	171	199	146	191	86	103	71	105	474	598
150. Lift model	188	231	160	213	97	128	73	123	518	695
151. Vacuum, electric	125	133	146	148	99	104	79	93	449	478

TABLE 20 (continued)

152. Oscilloscope, cathode ray	16	17	50	52	55	60	68	86	189	215
153. Radiometer	102	105	121	139	91	114	74	111	388	469
154. Radio receiver, demonstration panel	30	39	41	41	39	39	45	49	155	168
155. Rectifier, Tungar	20	21	33	33	33	42	45	59	131	155
156. Reflectors, parabolic	30	49	52	102	37	68	55	154	174	373
157. Rods, 40 cm long	104	446	88	506	55	358	59	831	306	2141
158. Rod, 100 cm long	69	324	57	365	45	394	53	772	224	1855
159. Rods, assorted	83	476	80	543	53	389	56	672	272	2080
160. Rotator, electric	41	44	38	45	38	43	54	71	171	203
161. Resistance boxes	158	274	159	372	93	325	77	674	487	1645
162. Scale pans	99	264	88	368	58	336	43	232	288	1200
163. Sheath, rubber	54	88	54	146	40	61	41	112	189	407
164. Singing flame apparatus	11	11	28	31	26	32	41	43	106	117
165. Soldering gun or elec. soldering iron	76	93	80	93	58	70	64	89	278	345
166. Sonometer, simple form	98	133	102	128	85	119	72	148	357	528
167. Silk	182	228	155	211	85	147	75	253	496	849
168. Speaker, perm. magnet	48	63	54	72	36	51	44	90	182	276
169. Specimens, spec. heat	129	421	133	591	85	734	73	1221	420	2969
170. Specimens, spec. grav.	153	583	153	823	95	801	78	1315	479	3522
171. Specific gravity bottle	138	461	142	561	97	685	76	921	453	2628
172. Spectroscope, direct vision	28	31	56	63	52	61	58	79	194	234
173. Static machine, Van de Graaff	44	44	51	52	40	41	32	35	167	172
174. Static machine, Wimhurst	92	95	110	111	61	62	66	73	329	341
175. Storage cell apparatus	102	181	91	171	72	157	53	211	318	720

TABLE 20 (continued)

176. Stethoscope	29	31	26	30	17	23	15	38	87	122
177. Stirrups for bar mag.	76	277	82	281	51	224	53	268	262	1050
178. Support, magnet	67	124	68	186	43	141	52	213	230	664
179. Switch, knife, one pole	201	548	163	270	97	522	83	669	554	2309
180. Switch, knife, two pole	167	438	153	498	96	459	80	644	496	2039
181. String vibrator	43	59	52	72	25	25	50	60	180	216
182. Stroboscope, neon	8	9	14	14	12	12	34	51	68	86
183. Syringe, pressure	36	62	34	42	24	38	28	53	122	195
184. Taps, cell	87	153	31	164	20	128	28	556	166	1001
185. Tank, refraction	46	52	56	66	36	47	45	54	183	219
186. Telegraph set	190	276	159	252	94	181	78	290	521	999
187. Telephone station	80	104	77	112	46	67	47	96	250	379
188. Television receiver	15	18	13	15	15	25	14	20	57	78
189. Thermocouple	47	57	65	82	53	71	60	103	225	313
190. Thermometers, C & F	245	1696	195	1909	103	1292	85	1820	528	6717
191. Timer, interval	35	40	43	64	32	34	36	53	146	191
192. Timer, stop watch	119	135	71	93	52	59	57	94	299	381
193. Time control, elec.	2	3	10	11	11	11	13	13	36	38
194. Tripod	212	1024	164	1258	90	741	69	660	535	3683
195. Tripod base	109	443	65	485	42	251	46	383	262	1562
196. Trough, pneumatic	204	1497	161	1892	77	854	39	222	481	4465
197. Transformer, demonstration	97	134	106	142	60	73	70	104	333	453
Tubes:										
198. Calibrated for liquid pressure	28	47	28	66	11	18	25	67	92	198
199. Cathode ray	25	35	47	76	37	55	58	121	167	287
200. X-ray	11	11	25	27	38	45	58	82	132	165
201. Guinea & feather	43	46	68	72	53	59	67	78	231	255
202. Barometer	119	178	137	222	76	170	67	142	399	712
203. Resonance	114	178	121	270	90	282	78	342	403	1072
204. Tubing, glass (lbs)	243	2688	185	2598	98	955	70	799	596	7040
205. Tubing, rubber (ft)	244	3916	180	3915	101	2175	77	1703	603	11709

TABLE 20 (continued)

206. Tuning forks	280	1432	217	1496	119	1023	86	1383	702	5334
207. Tuning forks, sympathetic pair	87	112	115	172	82	112	78	115	362	511
208. Universal light source	73	85	77	93	60	80	48	82	258	340
209. Voltmeter, A.C.	163	256	165	309	96	221	75	398	489	1184
210. Voltmeter, D.C.	189	315	177	440	102	384	77	630	545	1769
Weights:										
211. Hooked, set	190	402	163	455	86	358	75	713	514	1928
212. Metric, slotted	191	393	177	595	101	587	70	872	539	2447
213. General laboratory	183	493	155	812	89	717	66	659	493	2681
214. Set, 1 to 500 gms.	177	627	134	734	85	708	60	753	456	2822
215. Wire, bell #20	154	1943	140	2143	86	1056	71	961	449	6103
216. Wire, steel, assorted	111	416	103	1118	66	561	60	514	340	2609
217. Worm and gear set	25	25	26	29	32	32	54	58	137	144
218. Wheatstone bridge, slide wire model	168	234	156	310	98	293	81	507	498	1344
219. Wheel and axle	194	306	174	339	96	265	80	367	544	1277
220. Vibrograph	55	69	73	92	59	93	54	116	241	370

1-199, 14 students in 1.0 section; 200-499, 18 in 1.1; 500-999, 36 in 1.8; and 1000-up, 111 in 4.7. These statistics were used for interpreting data in Table 20. Analyses of data for each enrollment category were made separately.

Schools in the 1000-up size group. According to Table 20, 1227 calorimeters were present in 79 of the high schools. This was an average of 15.5 calorimeters per school (1227 divided by 79). It follows, therefore, that in these schools there was an average of 7.2 students per calorimeter (gross) (111 divided by 15.5). Since there was an average of 4.7 class sections of physics in each of these schools, perhaps a more meaningful comparison between the number of students per calorimeter would be 1.5 to 1 (net) (7.2 divided by 4.7).

On the other hand, this item of equipment was absent in 11 or 12.2 percent of the high schools. Physics was offered, however, in only 6 (90 minus 85; remainder from 11) of the schools. Thus, an equivalent of 666 (111 times 6) physics students were deprived of firsthand classroom experiences with a calorimeter.

Schools in the other size groups. Analogous statistics on calorimeters for the schools in these size groups are given in the following tabulation. For comparison, the figures from above are tabulated in the 1000-up column.

An analysis of these statistics discloses that as the size of the high schools increased, the average number of calorimeters per school also increased; so did the gross number of students per calorimeter except for the decrease in the 200-499 enrollment category. On the other hand, the net number of students per calorimeter was the lowest in the largest schools.

Calorimeters were absent in a higher percent of the small high

Type of Analysis (Averages)	Size of School 1-199	200-499	500-999	1000-up	Mean
1. Number per school	3.2	5.2	8.0	15.5	8.0
2. Number of physics students per school	14	18	36	111	45
3. Number of students per item (gross)	4.4	3.5	4.5	7.2	4.9
4. Number of students per item (net)	4.4	3.2	2.5	1.5	2.9
5. Percent of schools not having item	51.0	30.8	19.4	12.2	28.3
6. Number of students involved in #5	0*	576	792	666	2,034 (Total)

* Schools without calorimeters were not offering physics during the 1958-59 academic year.

schools than in the large ones. One-tenth of the physics students were in schools not having a calorimeter.

Summary on quantity of equipment. Inventories of science equipment and the number of high schools in which each item was present and absent were categorized by size of school and science area. Data were analyzed with respect to the number of each item per school, per classroom - when significant, and the number of science students per item. The portion of schools not having certain items of science equipment and the number of students in these schools were determined. An illustration using one item of equipment selected from each inventory table showed how the data were interpreted. These techniques can be applied to all other listed items of equipment.

Considerable variation was noted in the quantity of science equipment available and the number of science students per unit in the various sizes of high schools. As the size of the schools increased, the variety of items and the number of each item also increased. Even though the large schools had a greater number of science students per item of equipment than the small schools, they had several class sections of each

science subject, so the net number of students ver item decreased substantially as school size increased.

The percent of high schools in which the various items of science equipment were absent was generally the highest in the small schools and the lowest in the large schools. A smaller portion of science students in the large schools was thus deprived of firsthand experiences with science equipment than in the small schools.

The equipment listed in Tables 17 through 21 for teaching courses in science was, in some instances, missing completely at the high schools. In 27 of the schools, none of the general science items was found. A breakdown by school size disclosed that all of these items were missing at 12 of the schools in the 1-199 size group; at 10 in the 200-499 group; 3 in the 500-999 group; and 2 in the 1000-up group.

The following tabulation gives similar statistics for the other three traditional science courses.

Course	Number of High Schools in which None of the Items was Found	Breakdown by School Size			
		1-199	200-499	500-999	1000-up
Biology	9	7	1	0	1
Chemistry (Student Lockers)	103	75	16	6	6
(General Lab.)	28	24	2	1	1
Physics-Items 1-35	28	23	3	1	1
36-72	87	60	22	4	1
73-109	71	50	18	2	1
110-146	72	52	17	2	1
147-183	81	56	22	2	1
184-220	71	50	17	3	1

Semi-micro laboratory equipment was available in only 10.2 percent of the 636 high schools offering chemistry during the 1958-59 academic year.

Very few science departments in the 855 high schools had an adequate assortment of tools. The equivalent number of certain tools per school was: screw driver, 1.2; pliers, 0.84; hammer, 0.62; wire cutter, 0.53; crescent wrench, 0.35; hack saw, 0.30; handsaw, 0.28; and table vise, 0.26. The supply of tools was such that one-fourth to one-third of the science departments could have had a table vise, handsaw, hack saw, and crescent wrench; one-half to two-thirds of them could have had a wire cutter and a hammer; four-fifths a pair of pliers; and all of them a screw driver.

SOME GENERALIZATIONS

To show that the high schools in the random sample were reasonably typical of those throughout the United States, the following tabulation is presented.

Type of High School			Size of High School		
Type	Percent Sample	* U.S.A.	Size	Percent Sample	* U.S.A.
Jr.-Sr. 6-yr.	33	42	1-199	44	59
Regular 4-yr.	60	49	200-499	30	26
			500-999	15	9
Senior 3-yr.	7	9	1000-up	11	6

* The most recent data available were compiled for the 1951-52 school year.

A statistical comparison was made between these two sets of data by means of the chi square formula. The derived values of chi square were such as to permit the acceptance of the null hypothesis of no significant difference at the 32.7 and 18.7 percent level of confidence for type of school and size of school respectively.

It is probable that the differences in percents representing high schools in the sample and those in the United States as a whole were due to reorganization and consolidation which took place since 1951-52.

A greater portion of high school students is studying science today than three years ago. This is discernible from the following tabulation:

Subject	U. S. Office of Education Study 1955-56 Percent	This Study 1958-59 Percent
Biology	20.3	24.5
Chemistry	7.6	10.2
Physics	4.6	5.6

Combination classrooms and laboratories (multipurpose rooms) are becoming the most popular type of facility for science instruction, thus replacing the traditional separate lecture and laboratory rooms so common during the first half of this century. Entirely too many high schools, however, were still using regular classrooms for science classes because their facilities did not include enough rooms equipped specifically for science work.

Many science classrooms and laboratories were inadequately equipped for effective instruction. In a number of schools, it was noted that facilities and equipment were geared to the academic background and interests of the present or past instructor(s). They were good in his major field(s) of interest but woefully weak in other areas. High school administrators have a responsibility to see that a reasonable balance of equipment and supplies is maintained for the various science classes.

A definite relationship exists between the size of school and status of the facilities and equipment for science instruction. Large high schools as a group had better presentation and laboratory facilities and equipment than the small schools.

Since roughly one-half of the high schools lacked adequate space for laboratory work and one-third of them lacked proper science equipment storage facilities, every effort should be made by school administrators and the local school trustees to rectify these conditions. The location of science classrooms and laboratories was such that minor enlargement and modernization were feasible in approximately one-half of the schools.

Roughly six out of every 10 high schools had annual budgets for procuring science equipment, and about five out of 10 had annual budgets for science supplies. For the 1958-59 school year, these funds totaled

$620,846.00. When compared with the 1957-58 total allotment, it represented an increase in 46 percent, no change in 40 percent, and a decrease in 14 percent of the schools.

Even though the percent of high schools having budgets and the amount of appropriated funds increased as school size increased, the amount per student decreased as school size increased. The amount available per student in the four enrollment categories was: 1-199, $3.90; 200-499, $2.88; 500-999, $2.50; and 1000-up, $2.26. The overall average, based upon total science enrollment in the 855 high schools, was $2.66 per student. This amount is equivalent to the price paid for ten packages of cigarettes!

According to the reports submitted by the investigators, there were many non-academic programs in the schools visited for which adequate or generous funds were available per student participant, whereas funds for science education were meager and obviously inadequate in the same school. Science teachers should be able to depend upon an appropriate amount of money each year for the procurement of equipment and supplies. This would permit long-range planning and a steady improvement in the variety and quantity of laboratory and other instructional equipment. A guaranteed basic allotment per science student is one effective way by which projected budgets can be estimated.

Assuming that one of the school's important functions, probably the unique one, is academic in nature, administrators should provide first for adequate financing not only of science programs but of all academic programs, and second for non-academic programs.

As conventional fuels and the "Iron Age" give way to the atomic and space era, can the American people, the elected school trustees, and school

administrators expect science programs to keep abreast of the times when annual budgets were provided in only 59 percent of the high schools; when the amounts provided in one-half of the schools represented no change or a decrease from the preceding year; and when about one-fifth of the schools required science students to pay breakage and laboratory fees?

The need for adequate science budgets is enhanced by the fact that a relatively small number of high schools were recipients of funds from out-of-school sources and of donated or borrowed equipment. Except for Federal Surplus Property, these sources contributed only meager amounts of funds and equipment. Almost six schools in every 10, however, were making extensive use of improvised equipment.

A change in the procedures used for procuring science equipment and supplies could result in a more efficient use of available funds. Many high schools still permit teachers and administrators to make purchases directly from supply houses. Only 10 percent of the schools pooled their orders and submitted them to suppliers for bids; yet this technique is used by most business concerns.

If science teachers are going to be effective in bringing about an improvement in science education programs in the high schools, they must be allotted special time for doing some of the added duties associated with their positions. These duties involve the keeping of an up-to-date inventory of science equipment and supplies - such an inventory was available in about one-half of the high schools; setting up equipment for demonstration and laboratory work; and maintenance of equipment. Time for these latter two duties was provided by 34 and 18 percent respectively of the schools. A portion of the needed time could be obtained by eliminating all duties unrelated to science teaching from the assignment of science

instructors.

A look at the high schools in which the basic items of equipment for teaching the various science subjects were missing discloses that a greater portion of items was absent in schools enrolling less than 200 students than in those with enrollments of 500 and above. Many investigators, including Dr. Conant, indicate that schools enrolling fewer than 500 students cannot offer the educational opportunities present in the larger schools. Every effort should be made, therefore, to bring about a consolidation of small high school districts, thereby broadening the base for adequate financing of the total school program. Equal educational opportunities for all American youth would thus move a step closer toward ultimate realization.

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